SCIENCE

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*RELATIONS OF GEOLOGIC SCIENCE TO EDUCATION.**

INTRODUCTION.

THE custom has been established which requires the retiring President of this Society, as other societies which have for their purpose the advancement of science, to set forth his views concerning matters related to the interests which the association seeks to promote. This custom evidently rests on the reasonable presumption that the officer during his term of service has been led by his duties to consider how the cause which he represents may be promoted, how its store of truth may be enlarged, and in what manner it may best be made to serve the interests of mankind. This task may be essayed either by a survey of the work which has recently been accomplished in the science, with appropriate comment on the trends and results of the endeavors, or the essayist may restrict his undertaking to some one portion of the field with which he is conversant in the hope that he may be able to present the fruits of his own labors in a way which is likely to be profitable to others. For various reasons I have chosen the latter of these alternatives and have taken for my subject the relations of geological science to education. Under this title I shall not only include those questions

* Annual Address by the President, N. S. Shaler, Read before the Geological Society of America, December 27, 1895.

which pertain to pedagogy, but certain larger aspects of the matter which relate to the needs of society, both from the moral and the economic point of view.

RELATIONSHIP OF TEACHING AND RESEARCH DEFINED.

I have been in good part led to take up this subject for the reasons that the title itself is a protest against the modern notion that the work of research should be separated from that of teaching; that natural inquiry should be released from the ancient and profitable connection with education, which in my opinion has advanced and ennobled both these branches of learning. Those who seek to have inquiry endowed are led to the endeavor by a true sense of the importance of the tasks with which the path-seekers in the fields of nature have to deal. They are, moreover, guided to their object by the motive which leads to the division of labor in all work which men do, whether in economics or in pure learning. Undoubtedly a certain kind of success would attend the complete separation of the students of phenomena from those whose business it is to impart knowledge; but there are gains which, though immediate, are not desirable, for the reason that they entail in the long run serious losses. It may well be apprehended that the definite separation of the inquirers in any science from those who are to teach the learning would result, on the one hand, in isolation of the men of the laboratory from the life of their time, and on the other, in a degradation of the instruction to a level where it would become mere formal tutoring, destitute of the penetrating spirit which gives value to scientific thought.

It seems to me that the explorer, if he be animated by the true spirit of his class, finds himself seeking for undiscovered realms, not for personal gains, nor, indeed, merely to add to the store of things known, but always with reference to the enlargement of mankind. His motive is in the highest sense that of the teacher; he limits his opportunities of personal culture if he denies himself the chance of communicating his gains to the youth of his time. It may be held that the investigator has his means of teaching through the press and the learned societies, but I need not tell my brethren of the craft that the opportunities of sympathetic contact with his fellow men which are thus to be had are very limited; that they are quite insufficient to satisfy the natural desire of an ardent student of nature for relations with the life about him. The only way in which a really wholesome situation can be found for the naturalist in any of the realms of nature is to link his work with the tasks of education.

Viewed from the point of view of the student of science, who has to catch the spirit of inquiry from the word of the master if he is to win it at all, we see that the teaching function of the inquirer is of the utmost importance to his science. We all recognize and deplore the evils which arise from the fact that young people have to be introduced to most branches of learning by teachers who have little chance to gain or to preserve the spirit of inquiry. We can at most hope that the scientific motive may come to these instructors through a study of the psychology which properly underlies their work. It is unreasonable to suppose that they will be able to bring to their work the stimulating influence of those who are a part of the learning they convey. Therefore, if men are to be bred in the ways of the naturalist, the task must be done by investigators. It goes, or should go, without saying that while these men may give and receive profit from their positions as teachers, they should not be called on to do the share of this work which is often inflicted on them, as it is on the teaching body of our schools in general. A condition of this combination of inquiry and in-

struction is that the two should be associated so as to give the men of science leisure for their studies as well as an opportunity to influence youths by their teachings.

INTERDEPENDENCE BETWEEN RESEARCH AND INSTRUCTION IN GEOLOGY.

There are good reasons why the connection between research and instruction should be preserved in geology, even if it be abandoned in the case of the other sciences. In those other branches of natural learning the subject-matter can be brought into the laboratory, or, at least, as in the case of astronomy, be in some measure made immediately visible to the student, but in geology only a very small part of the facts can be demonstrated by laboratory means. Even where the teacher finds himself in a field which is rich in illustrations, he is sure to lack examples of the greater part of the important facts which he has to bring to the understanding of his pupils. Under these conditions good teaching depends upon the development of the inquiring spirit without the stimulus of a satisfactory direct contact with phenomena. This task cannot be accomplished by any routine methods or by instructors who are not true men of science. It can only be done by those who have the spirit of the investigator in them, who know the range of fact in the intimate and personal way which will enable them to arouse the constructive imaginations of the youth to the task of picturing the unseen—a task which is at the foundation of the best culture which science has to give.

A capital instance of what can be done by a teacher who is also an inquirer is afforded by the work of Louis Agassiz in extending the interest in glacial geology in this country. His lectures on the subject were so vivid, they so effectively presented the physiognomy of the Swiss glaciers, that they quickened the imaginations of the dullest persons. They aroused an interest in the matter which was so intense and on the whole so well informed that the study of glacial geology in the larger sense of the term developed more rapidly and on better lines in this country, where existing ice fields are lacking, than in European lands, where examples abound. In such work we see the part of the master in instruction. As a contrast I may be allowed to relate a story which gives us a notion of what science teaching is likely to become when it is left to the people of routine.

The professor of mineralogy in Harvard University one day observed two young women examining his mineral cabinet, one of whom was evidently searching for some particular species. Offering his help, he found that the object of her quest was feldspar. When shown the mineral she seemed very much interested in the specimens, expressing herself as gratified at having the chance to see and touch them. The professor asked her why she so desired to see the particular mineral. The answer was that for some years she had been obliged to teach in a neighboring high school, among other things, mineralogy and geology, and that the word feldspar occurred so often in the text-book that her curiosity had become aroused as to its appearance.

It will, of course, be possible to give the routine teachers some practical knowledge of feldspar and of the other matters of fact with which they have to deal in their text-book work, but the motive, or the lack of it, which is indicated by the incident will always have to be reckoned on as inseparable from the millwork of ordinary schools. So far as geology is concerned, the instruction of this text-book kind which may be essayed in the secondary schools is quite in vain. Its only effect is to make the youths on whom it is inflicted quite unapproachable by the teacher who may afterwards undertake to introduce them to

geology. All of us who have taught in colleges know the youth who has had somebody's 'six weeks of geology' rubbed in by a drudge who, if required to do so, would in a like way have applied Sanscrit. We know that the youth who has been so misused is in most cases, provided he is not blessed with a good capacity for escaping the influences of education, utterly unfit for our uses. The most *economical* thing to do, in the large sense of the word, is to give him the advice which the elder Agassiz was wont to give to those of his students who proved impregnable to his methods of instruction: "Sir, you better go into business."

VALUE OF GEOLOGICAL EDUCATION AND METHODS OF TRANSMISSION.

Comprehensive Character of Geology.

Assuming, as we needs must, that as geologists it is our duty not only to extend the learning of the science, but also to take charge of its diffusion among the people, let us consider in general the value of good which we have to deliver and the manner in which the transmission may best be effected. So far, doubtless for the reason that geologists are uncommonly busy people, there has been little note taken of the importance of the store of the science to society or the way in which the knowledge should be handed down. We have been content to harvest and have hardly considered the work of cultivation; therefore the assessment which I am about to give will doubtless need much revision.

In the first place, we should note well the fact that geology differs from all other divisions of natural learning in that it is not limited to a particular group of facts or modes of energy; but is in a way concerned with nearly all the work which is done in and on this sphere. We should, perhaps, except human affairs; but if he is so minded the geologist may make good his claim to a large share in interpreting that group of phenomena also. In fact, the earth lore is not a discrete science at all, but is that way of looking at the operations of energy in the physical, chemical and organic series which introduces the elements of space and time into the considerations and which furthermore endeavors to trace the combination of the various trends of action in the stages of development of the earth. It is in these peculiarities of geology that we find the basis of its value in education and in the general culture of society, which it is the aim of education to create. It should be in its province, as it is clearly in its power, to give to mankind perspectives which will serve vastly to enlarge the evident field of human action.

All observant teachers know that no true success in education is possible until we contrive an awakening of the youth from the sleepy acceptance of the world about him. To rid the student of this benumbing relic of the bone-cave, the spirit of the commonplace, there is no treatment so effective as that which is in the power of the master in geology to give. The story of the ages clearly told, with a constant reference of the bearing of the matter on the appearance and the fate of man, will quicken any mind that is at all fitted to profit by the higher education. Although geology can hardly be said as yet to have made any such general impression on laymen as is justified by the body of truth which it has to deliver, the close observer may notice certain important changes in the state of the public mind which seem clearly to have been due to the teachings of the science. While many things go into the making of the world's judgments, there can be no question that the plain truths concerning the antiquity of the earth and the series of events which have led to the coming of mankind have in this generation been most effective in overturning sectarian bigotry and in

other ways enlarging the spirit of all educated people.

It is evident that the main contribution which geology has to make to those conceptions which may enter into the spirit of our society relates to the position of man; the abstract learning, that which is in and for itself, is for those who have the professional interest. These public values of the science are of two diverse kinds—on the one hand, those which pertain to intellectual enlargement; on the other, to economic development. Therefore in considering our duty by the educational side of our work we should see what the contributions can be to these two modes of endeavor and how they should be presented. First, I shall consider the limitations of that work which may be regarded as distinctly pedagogic.

Divisions of the Science.

It seems to me necessary distinctly to separate the body of the instruction which is to be given in geology into two parts—that which is appropriate to the general public; and that which, though 'caviare to the general,' fits the appetite of the professional-minded. We are indebted to the philosophical pedagogue Herbert for a statement of the self-evident proposition that interest in a matter must exist before information concerning it can be profitably communicated; therefore in our teaching we must take no end of care to provide this foundation for the attention. This care is particularly necessary in the matters of geology, for, as before remarked, the facts cannot often be exhibited in the experimental way, as in the laboratories of chemistry and physics, where the touch of hand or the sight of controlled actions establishes a personal relation with the problems. The teacher of our science has to avail himself of certain antecedent motives which he can presume to exist in any normal youth which may provide the required foundation of interest. What I have to say on this point is the result of nearly a third of a century of experience in teaching geology, and is based on work which has been done with more than 4,000 students. The basis for the induction is sufficiently great to make the conclusions of value. These are in brief as follows: That instruction in geology which is meant for those who have not acquired the professional motive, must find its basis of interest on either of two foundations—on the element of sympathy with all which relates to the fate of man which is native in all of us, or on the love of the open fields, which every youth who is not utterly supercivilized has as a birthright. Each of those interests is in a way primal; both may be separately reckoned on as strong in nearly all youths who are fitted for the higher education.

Class-Room Instruction.

To make use of the motives which may interest the beginner in geology my experience has shown that the first thing to do is to give by means of familiar lectures a general acquaintance with those series of actions which show the long continuous operations of energy in the orderly march of events, taking pains at each convenient opportunity—there are many such— to note how these processes have served to bring about the conditions on which the development of peoples or of states depends. Thus, in treating of volcanoes, the very humanized story of Vesuvius or of Ætna, especially the dramatic episode of the death of Pliny the Elder, is worth much to the teachers for the reason that it serves to bring a sense of human affairs into a subject which for lack of illustration is apt to remain remote and therefore uninteresting. The fact that the story of these volcanoes, especially that of Vesuvius, is inwoven with that of men forms a bond between the mind of the novice and an order of nature which would

otherwise be utterly unrelated to him. Again in treating of seashore phenomena, the history of harbors and their relation to the development of states, affords a basis on which to rest the account of coastline work. Yet again, in the matters connected with the formation of mineral deposits, which from the nature of the subject are apt to be somewhat elusive, it is easy to fix the attention by reference to the relation of those stores to the needs of man. So, indeed, in all parts of this preliminary work of awakening and developing interest in his subject, the teacher of geology, if he is to be successful, must go about his task on the supposition that he has to extend existing interests to his field. When men have for some hundred generations appreciated the earth as we would have them do it, the process of selection or the inheritance of acquired characteristics may give a birthright interest in the large problems of geology; but while here and there a youth may be found with a Hugh Miller's taste for the science, the teacher who reckons on having his class thus inspired will fail to achieve success.

Methods of Field Teaching.

As soon as the teacher through his work in the lecture room has succeeded in extending the natural inborn interests of his pupils to the problems of geology, instruction in the field should begin. In this part of the work there is need of a great change in the methods and aims of the teaching. While in the lecture room the conditions require the didactic method and exclude that of investigation, the reverse is the case in the field. When I first essayed peripatetic teaching I made the grave mistake in endeavoring to lecture with the phenomenon as a text. In time I found that the fatigue and other disturbing conditions of the open made students unable to profit by any such didactic method, and that all such direct instruction should be done while they were in the more receptive conditions of the house. The true use of the field is to awaken in the pupils the habit of seeking for themselves. The teacher may trust in this task to the existence of an observant motive in men which is at its best when they are in the open air. All of us, however dull we may be in the housed state, have when afield a discerning humor which prompts us to learn the reasons for the unexplained occurrences of nature. This precious relic of the savage life, of the original motive of curiosity, which has been the source of man's advance on the most of his intellectual upgoings, is in average youths strong; it requires the deadening effects of a long and misspent life to eradicate it in any normal human being. It is to this element of curiosity, informed by the preliminary instruction of the lecture room, that the teacher of field geology should mainly trust for his success.

In practice it will be found impossible completely to exclude didactic teaching in the field—such arbitrary divisions of methods are generally impracticable—but when in face of an exhibition of any geological phenomena, with the briefest possible preliminary, designed to fix the attention of the class upon the facts, the teacher should at once become a mere questioner, a goad to arouse the men to a like interrogation of the things they see. It is important that the first problems of interpretation which are essayed should be of the simplest order, for immediately successful work in the unaccustomed harness is much to be desired. Thus the determination of strikes and dips, the identification of visible faults, and, above all, the careful recording of such facts, should come first and the work be carried to distinct success before any effort is made to use the results in the larger interpretations as to the attitudes of strata. In my experience it is the most desirable in the early part of the field training to give all

that can be obtained in the way of work which relates to causes of action, and thus, for the reason that men, however great their training may otherwise be, are unlikely to conceive the earth about them as a realm of continuous processes, their geology is thus not brought down to the present period. The beds and banks of the streams, the retreating escarpments, the shores of lakes and of the ocean—above all the, when rightly discerned, majestic phenomena of the soil—all may serve to impress the pupil with the activity of the earth, and thus clear his mind of the natural but blinding conception that after its creation time the sphere entered on an enduring rest.

Difficulties Encountered in Field Teaching.

In my experience the difficulties which have to be met in field teaching, apart from the hard labor involved in the simultaneous exercise of mind and body, consists in the struggle which the instructor has to make with the incapacities which arise from the supercivilization of his pupils. These hindrances are protean in form, but they are most commonly to be found in an inability to think in three dimensions any better than we can in four, and an incapacity to continue any work when alone. As to the first of these defects there seems to be no resource except to revive the natural dimensional sense which primitive people have. If the student has had sound training in solid geometry he may the more quickly recover the capacity to form the special conceptions which are required of the geologist; but the natural solid is quite another thing from the ideal, and while the theoretical view of them is the same the practical experience is very different. Some youths never learn to deal with the earth problems from the solid point of view. They are therefore cut off from the better uses of the field; yet even with this signal disadvantage they may do good work in certain parts of the science. One of the most distingushed of our American geologists, now dead, was, perhaps on account of the fact that he saw from but one eye, quite without the sense of the relations of the solid; yet, while in the field work his success as measured by his talent was limited, his contributions in other departments were great and of enduring value. Nevertheless, though the people who abide in two dimensional spaces may possess abilities of a high order, they should be kept out of the science which more than any other calls for the ability to frame three dimensional conceptions.

An inability to work alone in the field is a rather common, and in my experience an incurable, defect in certain students who would otherwise be fitted for geology. Those who are thus afflicted appear to lose their motive of inquiry when they are parted from their fellow men. Their malady is to be regarded as one of the many defects of body and mind which are due to over-housing—to that absolute separation from the peace of the wilderness which characterizes our city life.

As soon as possible the field student should be brought to the point where he is required to make his own maps, at first as sketches, and then in the more formal way by pacing, with some methodical control, such as by a simple triangulation. One piece of such map work where the delineation of the surface in general ground plan and contour, as well as the geological coloring, is from his own labor will often be sufficient to affirm the working power of the man. In the ideal of the system such instruction should come to every student who undertakes the study of geology, but in practice it will probably be gained by very few. In the department of Harvard University which is devoted to the science 300 men each year enter on the elementary work. Of these not more than the eighth

part continue the study to the point where they may begin to do work which may be regarded as independent; yet fewer essay the training which looks forward to a professional career. As this department has been long established and is favorably conditioned to give instruction, the lack of a large attendance under a system of free election by students may be taken as an indication that while the elementary didactic presentation of the science attracts the greater number of the youths of our colleges, the higher branches are less attractive than the other similarly difficult work of the indoor learning, The conclusion is that geology in the larger sense of the term is, at least in the present condition of culture, an interest for a few chosen spirits who are so fortunate as to be born with a share of the world sense, or at least with an aptitude for studies which demands a measure of the primitive man which is not to be found in the most of our supercivilized folk.

Undesirability of Teaching Geology to Immature Students.

In the demand which is now made for a beginning of all our sciences in the secondary schools it is proposed to include geology in the list and to set boys and girls of from fourteen to seventeen years of age at work upon the elementary work of the learning. For my own part, while it seems to me that some general notions concerning the history of the earth may very well be given to children, and this as information, it is futile to essay any study in this science which is intended to make avail of its larger educative influences with immature youths. The educative value of geology depends upon an ability to deal with the large conceptions of space, time and the series of developments of energy which can only be compassed by mature minds. Immature youths, even if they intend to win the utmost profit from geology, would be better occupied in studying the elementary tangible facts of those sciences such as chemistry, physics or biology, sciences which in their synthesis constitute geology, rather than in a vain endeavor to deal in an immediate way with a learning which in a good measure to be profitable has to be approached with a well developed mind. The very fact that any considerable geological problem is likely to involve in its discussion some knowledge of physics, chemistry, zoölogy and botany is sufficient reason for postponing the study until the pupil is nearly adult.

EXPERT WORK AND ITS INFLUENCE AND REQUIREMENTS.

Besides the relations to society which may be established by his position as a teacher, the geologist is from the character of his studies much called on for another kind of help, that which pertains to the development of earth resources or to the litigation which concerns earth values. In this field the relations are more critical and more perplexing than in that of instruction. The results of blundering are more apparent and their immediate effect on the reputation of the science more unhappy. That this branch of learning has managed to retain a fair place in the esteem of the public in face of the criminal blunders which its prophets have made is indeed remarkable. It shows how much our people are disposed to pardon where they believe that men mean well, however ill they may do. There is, however, a lesson from this unhappy experience which we should all read and inwardly digest. This is in effect that what is called expert work demands other qualities of mind and another training than those which go to make a successful investigator or teacher. We, as well as the general public, need to recognize that fact, that there is as much reason to suppose that a noted teacher of political economy should prove successful in determining the merits of a proposed business project as that his colleague in

geology should be fit to advise in regard to a mining venture. The teacher may be an expert in the economics of the profession, but the proof of the fact is not to be found in his scientific work or in his success as an instructor. If he has not had the other training it may be safely assumed that he will be totally unfitted to wrestle with the tricky fellows who try in amazingly varied ways to deceive him, or even with the tendencies of his own mind, which naturally lead him to see riches where others fancy they discern them.

In the interests of our science it is most desirable that all expert work should pass into the hands of a body of men who should bring to their task so much of geology as is needed for the particular inquiry, commonly not very much, and who can join with it the more important practical acquaintance with the miner's art and the conditions of trade which relate thereto. In certain cases the men of theory may well serve these experts; all their inquiries are likely to be of service in the determinations, but on them should not be the responsibility for the business side of the problems. There is little the geologist does in the way of research which may not have some practical application to the affairs of men, but he should not mistake this possibility of usefulness as an indication that it is for him to give his inquiries an economic turn.

CONCLUSION.

We thus see that geological science, like the most of the other branches of natural learning, has two distinct points of contact with society—that of instruction and that of economic affairs. In each of these fields of usefulness its services to man have been great and are to be far greater in the time to come. As for instruction, the task is to give to men an adequate perspective for their lives. It is to ennoble our existence by showing how it rests upon the order of the ages. In the economic field it is to show the resources which these ages have accumulated in the earth for the service of the enlarged man, who is to attain his possibilities by a full understanding of his place in nature. To do the fit work we need to combine the functions of explorers and guides zealous to open the way to the unknown, and those of teachers who take care that the youth of our time are led into the land which we know to have so much promise for man.

SOME VALUES OF STELLAR PARALLAX BY THE METHOD OF MERIDIAN TRANSITS.

IN this article are presented values of the parallax for thirteen of the list of nearly ninety stars upon which I have been engaged at this observatory the past two years. The results here given include the values presented at the Springfield meeting of the American Association for the Advancement of Science, with some additions. They are the results of preliminary solutions based upon all my observations of these stars available at the time, and equal weight has been given to each observation.

The method employed is that of the differences of meridian transits, and it is believed this is its first application since it was introduced in its present detail by Prof. Dr. J. C. Kapteyn at the Leiden Observatory in 1885–87. He determined the parallaxes of fifteen stars by this method with a high degree of accuracy. The observing consists in noting the successive times of transit of three stars, of which the first and third are comparison stars and the middle star is the one whose parallax is sought. The former should be so chosen as to make the group of three stars as symmetrical as possible in both position and magnitude. Of course, a fine meridian instrument is required, and for the present series the REPSOLD meridian circle of 12.2 c.m. was employed with a power of 180 diameters. To

give the instrument greater freedom the clamp arm was detached from the pier, excepting for a few of the earlier observations. Screens of fine brass wire were used to reduce the apparent magnitude of the brighter stars so as to make them more comparable with the fainter stars. The screens were mounted on a frame travelling north and south and entirely separate from the instrument. They were used not for fear of the errors arising from momentary uncertainty on the part of the observer, but for fear of a systematic change in his habit of noting the bisections of the brighter stars. Such a change might come about gradually during the six months' interval between two successive epochs of observation and would enter directly into the concluded parallax. To prepare each observation of a group of three stars for combination with other observations of the same stars a simple reduction is made. The differences of the observed times are corrected for deviation of the instrument from the meridian and for proper motion of the stars so far as they are known, and then reduced to a common equinox. The effect of the clock rate in well selected groups of stars is rarely appreciable. The solution is then made so as to determine three unknown quantities, namely, the normal difference in time between the middle star and the point exactly midway between the first and third stars, the residual correction for proper motion and the parallax.

The method has certain distinctive advantages and disadvantages to be foreseen which may here be noted. The former are as follows: 1. The absence of any known systematic effect of refraction, thus avoiding any refraction term whatever in the reductions. 2. The simplicity of the observations and reductions and the rapidity with which the former may be secured. 3. The great freedom allowed in the choice of comparison stars as regards distance from the principal star in zenith distance. 4. The stability of the instrument and the fact that it is untouched at the moments of actual observation. 5. The ease with which the condition may be secured that all observations on a given star shall be made with the same position of the instrument and of the observer. As compared with one or another of the modern, refined methods of measuring stellar parallax, the following advantages may also be given: 6. A large dimension of the parallactic orbit is always measured. 7. All observations are made at the same place in the field of the eyepiece. 8. The attention of the observer is directed to one point only at a time.

The disadvantages are as follows: 1. Limitation to meridian passages, so that observations at the time of maximum effect of parallax are in general impracticable through one-half of the year. 2. Limitation in the choice of comparison stars, since brighter stars must be selected on account of the smaller apertures of meridian instruments. This necessitates moreover greater intervals between the stars allowing more time for disturbances to occur affecting the transits of the stars. 3. The necessity of moving the entire telescope in passing from one star to the next, sometimes requiring a change of several degrees in the pointing of the instrument and incurring the risk of inducing strains among its parts. 4. The fact that the instants of observation of any two stars cannot be made simultaneous.

The present observations were made on an illuminated field. In making up the star groups I gave the preference to symmetry of position over that of magnitude. The observing list has seemed too crowded in some places, but the influence of this and of any other adverse circumstances will be better determined by the final discussion. In order to secure, if possible, a fair number of observations at each epoch, I have continued the observing in general on poor

as well as on good nights. Numerous observations have been made on miscellaneous stars, with and without the screens, to determine at any time the personal equation depending upon the apparent brightness of a star; but these have not yet been reduced.

The values of the parallaxes resulting from the present solutions are given in Table I. The average number of observations entering into each value is 35. All the stars have been solved in the regular manner except the last two, which presented a peculiar case to be explained in the following. Of these *85 Pegasi* was reduced with its second comparison star only with an inappreciable parallax as the result.

In Table II. are presented all the previous determinations of parallax that I have found for the stars of Table I., excluding some older and much more uncertain values. The several columns are sufficiently explained by the headings except the third, and here the letters given denote different methods of observing, as follows:

H. By the heliometer.

M_1. By the filar micrometer attached to the equatorial telescope and from measures of distance and position angle combined; M_2, from distance alone; M_3, from position angle alone; M_4, from differences of declination.

Z. By measures of the zenith distances of the parallax star alone, in the meridian.

R. By observations of right ascension in the ordinary manner.

P. By measurement of photographs.

T. By differences of meridian transits employing special comparison stars.

In the case of *α Lyræ* the letter *c*, in the fifth column, indicates that the measures were made from the companion star. The value given for this star from *Peters* is the only *absolute* parallax in the table. For *μ Cassiopeiæ* and *α Lyræ* I have included my own results, assigned the several independent values different weights, somewhat arbitrarily, and combined them all into one mean value given in the table.

TABLE I.

NAME OF STAR.	Mag.	R. A.	Dec.	Prop. Mot.	Parallax.
		h	°		
μ Cassiopeiæ	5.2	1.0	+54	3.″8	+0.″12
Lalande 15290	8.2	7.8	30	2.0	+ .10
Lalande 15565	7.5	7.9	29	1.2	+ .03
Lalande 18115, *pr*	8.0	9.1	53	1.7	+ .15
δ Ursæ Majoris	3.2	9.4	+52	1.1	+ .13
20 Crateris	6.2	11.5	−32	1.1	+ .15
γ Serpentis	4.0	15.8	+16	1.3	+ .13
η Herculis	3.7	16.6	39	0.1	+ .20
Lalande 30694	7.0	16.8	0	1.6	+ .02
70 Ophiuchi	4.2	18.0	2	1.1	+ .17
α Lyræ (Vega)	0.2	18.6	38	0.4	+ .05
Lalande 47019	8.1	23.9	26	..	+ .24
85 Pegasi	5.8	23.9	+26	1.3	+0.02

TABLE II.

NAME OF STAR.	Authority.	Method.	Parallax.	No. of Comp. Stars.	Probable Error	Weight.
μ Cassiopeiæ	O. Struve	M_1	+0.″342	1	±0.052	6
	Schweizer	M_3	+ .084	1	.060	5
	Pritchard	P	+ .035	2	.018	10
	Flint	T	+ .120	2	.044	8
	Weighted Mean.		+0.130		±0.020	
δ Ursæ Majoris	Kapteyn	T	+0.052	2	±0.026	
η Herculis	Belopolski (Wagner)	R	+0.40	..	0.072	
70 Ophiuchi	Krueger	H	+0.150	2	0.006	
α Lyræ	W. Struve	M_2	+0.262	c	±0.025	4
	C.A.F. Peters	Z	+0.116	..	.050	4
	O. Struve	M_1	+0.147	c	.010	8
	Johnson	H	+0.141	2	.047	2
	Brünnow	M_1	+0.212	c	.011	6
	Brünnow	M_4	+0.188	1	.033	2
	Hall	M_4	+0.134	c	.006	10
	Elkin	H	+0.092	6	.019	10
	Flint	T	+0.049	2	.037	6
	Weighted Mean.		+0.138		±0.008	
85 Pegasi	Brünnow	M_1	+0.054	1	±0.019	

As regards the apparent uncertainty of results, the present method cannot take rank with the best work done with the heliometer and the filar micrometer, or perhaps with that done by the aid of photography. As shown by Dr. KAPTEYN'S refined determinations, however, this method seems singularly free from systematic error, and its trustworthiness may be higher than that assigned by its accidental error alone. In the present series a material reduction of the apparent uncertainty of any single night's observation of a given star would result from diminishing the weights of the

poorer nights. The average probable error of the parallaxes of Table I. is $\pm 0.''046$, and, therefore, the true values should be within one-tenth of a second of the numbers there given. When we consider average values of parallax, however, we have a more trustworthy determination of the distance of certain stars as a class. Thus ten stars of the list have a proper motion of one second or more. The mean value of their parallaxes is $+0.''11$, with a probable error of $\pm 0.''015$, so that the average distance of these stars is indicated to be such as to require about thirty years to be traversed by light. Table I. contains one star, *Lalande 47019*, which found entrance quite unexpectedly. It was the first comparison star for *85 Pegasi*, and the latter was first reduced in the regular manner but showed a negative parallax. This was explained upon making comparisons of the first star, *Lalande 47019*, with *85 Pegasi* and the third star of the group separately, for the two solutions resulted in positive and nearly equal values of the parallax for the first. The mean of these two values, $+0.''21$ and $+0.''27$, is given in the table. An inspection of the data indicates that this is a real parallax, and not merely an apparent one such as might be ascribed to personal change. The magnitudes of the stars were 8.1, 6.1, 6.2 respectively, and no screens were employed in this group. I included in the examination a number of observations made with the screens expressly as a control on the personal equation depending upon the brightness of the stars. The case of *Lalande 47019* is an interesting one, since the star is faint and the comparison of four catalogue positions extending from 1800 to 1890 gives no plain indication of proper motion. Yet the results indicate that it is the nearest star of the thirteen in the table. With this separate presentation of *Lalande 47019* and *85 Pegasi*, it will be noticed that while some of the parallaxes are very small yet they are all positive. According to the law of chances some of these values should be the lowest possible ones derivable for the individual stars and some should be the highest possible values. The fact that they are all positive and comprised within so limited a range indicates that the observations are not liable to such systematic errors as have even led sometimes to large negative values of parallax, and strengthens the hypothesis that the stars of large proper motion are on the whole comparatively near us.

In the case of two of the stars we have several independent determinations as shown in Table II. For η *Cassiopeiæ*, one of the stars having a remarkably large proper motion, the results indicate a definite parallax of about $0.''13$. The number of separate determinations, however, is few, and we can only say that the chances are that the distance of this star is such that it requires somewhere from 22 to 30 years for its light to reach us. α *Lyræ* has been a favorite object for parallax observations, owing to its brilliancy and its favorable position for northern observatories, and consequently we have a good determination of its distance. The concluded value of the parallax, $+0.''138$, corresponds to a light journey of 23.6 years, and the uncertainty of this result is so small that the chances are that the time actually required is somewhere between 22.3 and 25.1 years, while we may feel confident it cannot be more than 33 years nor less than 18 years, that its light requires to reach our system.

A. S. Flint.
Washburn Observatory, Madison, Wis.

OZARKIAN EPOCH—A SUGGESTION.

Among the voluminous writings on various geological subjects published during the past ten years, there has been frequent mention made of an erosion interval occurring between the Lafayette formation and the lowermost glacial deposits. Those who

have studied the subject in the coastal plain or southeastern portion of the United States agree in asserting that this erosion period, was the longest and in every way the best marked of any that have prevailed over any portion of the continent since the close of the Tertiary Era. In that broad belt of unglaciated highland which occupies the interval between the inner edge of the coastal plain and the outer border of the drift-covered district, this post-Lafayette erosion period is as easily distinguished as on the lower country near the coast. Indeed, if the evidence of its length were derived solely from the amount of rock excavation accomplished, this inner district could be relied on chiefly to furnish this evidence. In both districts the period of erosion was begun by an elevation of the continent above its normal altitude, thus enabling the meteoric waters to institute a vigorously erosive system of drainage. It was terminated by a general subsidence of the eastern portion of the United States, and in consequence an extensive submergence in the coastal plain region and the Mississippi basin.

But in the drift-covered district, where evidence of this post-Lafayette elevation and erosion are not wanting, but frequently obscured by other phenomena, the upper limit of the erosion interval was the Kansan epoch of glaciation. This epoch was followed by another of erosion on the previously ice-covered region, which was itself many times longer than any which have succeeded it. These two important sub-divisions of the Glacial period are the chronologic equivalents of the latter portion of the post-Lafayette period of erosion as developed outside the limits of the glaciated district. Severing this latter portion there still remains a long period of sub-aërial erosion, the equivalent of what in the North has been denominated the pre-Glacial epoch of erosion. Recent studies have indicated that this early pre-Kansan erosion epoch constituted at least one-half of the post-Lafayette period of erosion. In fact, it occupied a very large part of the time which has elapsed since the close of the Tertiary era.

There is, I believe, general agreement among geological students that the post-Lafayette period of erosion is early Quaternary in age. I shall not argue this subject, but assume that it has been demonstrated by various writers that the period immediately supervened upon the close of the Tertiary era. Consequently, being Quaternary in age, the portion of it which intervenes between the institution of the era and the opening of the Kansan epoch constitutes the first and not least important epoch of the Pleistocene period (which, as I understand the consensus of opinion, is considered to date from the beginning of the era).

Now, up to the present time, so far as I am aware, there has been no specific term applied to this first epoch as here defined, except the rather indefinite one, pre-Glacial. As it presented features both in conditions of erosion, climate and flora, somewhat similar to those which characterized subsequent inter-Glacial epochs, and in marked contrast to those which characterized the Glacial epochs, all of which have been already named, it is evident that it deserves some specific application which will facilitate future studies into the natural subdivisions of the era. The name wanted might be secured in the coastal plain, but there it is difficult, if not impossible, to separate this from the subsequent epochs to which, as before stated, the latter portion of the pre-Columbian erosion interval belongs. Instead, we may more properly derive the desired term from some geographical designation of some portion of the unglaciated highland just without the glacial boundary. I hereby suggest that it be hereafter known as the *Ozarkian epoch*. True, while the post-Lafayette period of erosion is as well

represented by phenomena occurring in the Ozark Plateau region, the particular portion of it included in this epoch is no better demarked than in the coastal plain. But the Ozark region immediately adjoins a drift-covered region on which the Kansan drift sheet is widely exposed, and when the two regions have been exhaustively studied the relation of the drift to the valleys along the border will furnish data for discriminating the proposed Ozarkian epoch from that which followed. The geographical element of the term has been already used in geological nomenclature, as, for example, the Ozark Series, the Ozark Uplift and the Ozark Plateau, but the term as suggested differs so widely from those in use that it can never be confounded with them. Furthermore, the term is euphonious and in harmony with the nomenclature already adopted for the other epochs of the Pleistocene period.

The Ozarkian epoch as here proposed may be defined as a marked period of elevation and sub-aërial erosion instituted by the great post-Tertiary epeirogenic uplift of North America, and terminated by the Kansan epoch of widely extended glaciation. The following general table of the sub-divisions of the Quaternary Era graphically exemplifies its relative position:

QUATERNARY ERA.	RECENT P.	PRESENT EPOCH.....DEPOSITION. TERRACE EPOCH.....EROSION.
	PLEISTOCENE PERIOD.	Wisconsin Epoch...3d Glacial.....Drift. Toronto? Epoch.....2d inter-Glacial..Erosion. Iowan Epoch.....2d Glacial.....Drift. Aftonian Epoch.....1st inter-Glacial..Erosion. Kansan Epoch.....1st Glacial.....Drift. Ozarkian Epoch....pre-Glacial .....Erosion.
Lafayette Period.....Deposition.		

OSCAR H. HERSHEY.

FREEPORT, ILL.

[NOTE. The subdivisions of the Pleistocene period in the above table, except the last, are from Chamberlin's classification of the drift. The inter-glacial epoch between the Iowan and Wisconsin stages of glaciation has been provisionally named from the fossiliferous beds at Toronto, Canada, although it is considered far from certain that these strata belong to this epoch.

It is not customary to affix names to periods of erosion, although these are generally the longest and often the best marked divisions of geologic time. It has been suggested that it would be well to simply recognize the intervals of erosion, when encountered in any region, and wait until deposits occupying them have been discovered, before naming them. But in the case of the particular one under discussion, the conditions were such that no deposits contemporaneous with it are likely to be discovered. During the period of elevation which immediately succeeded on the Lafayette submergence the shore line was far beyond its present position, and the river alluvium and marine deposits of that epoch are buried under later formations and covered by the sea, where they can never be examined. Nor are there any correlative glacial deposits which could furnish a name to the epoch. The Ozarkian epoch as proposed is to terminate previous to the earliest Pleistocene glaciation of any portion of North America, except, perhaps, the far North. At present the Kansan epoch, which is to include the advance and retreat of the ice sheet which formed the so-called Kansan drift, is considered the first of the great glaciations. But if any decisive evidence of any previous distinct glaciation should be discovered it would constitute a new epoch and simply detract from the length of the Ozarkian epoch. The writer is of the opinion that the portion of the Quaternary era characterized by glacial conditions began at some time subsequent to the opening of the era, and it is to this distinctively pre-glacial portion that I wish to attach the name, Ozarkian epoch O. H. H.].

ORGANIC MARKINGS IN LAKE SUPERIOR IRON ORES.

AT the instance of Dr. Charles D. Walcott, Director U. S. Geological Survey, and with the kind permission of the editor of this paper, I beg to submit the following note, hoping that the subject may be brought to the notice of the officers of the U. S. Geological Survey, the Geological Surveys of Michigan and Wisconsin, etc., as well as that of all field workers among the rocks of

the iron-ore regions whose structural and paleontological geology in detail has yet to be unraveled, or is at present being worked up for publication, in this as well as in other countries.

I merely desire here and now to announce the discovery of traces of organic remains, made by me in fragments of iron ore from the Chapin mine, Iron Mountain, Menominee, Michigan, as well as possibly from other mines on the same range or elsewhere in the Lake Superior region. It is hoped shortly to publish a much fuller account of my work in this connection, in another place.

During the period of 1890–93, I collected a considerable number of specimens of iron ore from the ore piles on the docks at Erie, Pa., and was firmly of opinion that some of the markings upon them or in them were of organic origin, produced by animals of some kind; but being only an amateur geologist, I decided to submit the material to Prof. H. S. Williams, of New Haven, Conn., for examination. After seeing the specimens, Prof. Williams kindly wrote: "There are certainly some among them which resemble very strongly the trailings left by worms or crawling things on the sand."

The material was then forwarded to the U. S. National Museum, Washington, D. C., where Prof. Charles Schuchert, assistant curator of the Museum—Smithsonion Institution—examined them, and said: "The specimens of the Algonquin ores contain annelid trails."

Finally they were placed in the hands of Dr. Chas. D. Walcott for examination and he kindly reported as follows: "Most of the specimens from the Lake Superior region containing 'traces of organisms in Lake Superior iron ores' show only markings of mechanical origin. A few, numbers 10, 14, A, E and G, appear to be casts of the trails of a small annelid and are, I think, organic. It is not possible to identify them with any described species. For convenience of reference they can be referred to the genus *Planolites*."

Prof. C. R. Van Hise, geologist in charge U. S. Geological Survey, Lake Superior Div., also saw the specimens and remarks that in his opinion the markings might possibly have been produced by some complex movement or movements, but that they are very peculiar, and in any ordinary case would be unhesitatingly accepted as organic. My long-since-formed opinion as to the organic origin of these markings having thus been confirmed by the highest authorities, this discovery will doubtless add a new phase to the question or controversy regarding the origin and age of these ake-region iron ores, and iron-bearing series of strata, and also should tend to excite renewed and closer investigation of the Huronian rocks in search of better 'fossils' than mine, which surely exist and will eventually be brought to light.

Those especially interested could, no doubt, see these specimens on application to Prof. Schuchert, at Washington, in whose care I propose to let them remain for the present.

W. S. GRESLEY.

ERIE, PA.

FOOD OF THE BARN OWL (STRIX PRATINCOLA).

IT is well known that birds of prey disgorge the indigestible portions of food, such as hair, bones and feathers. These are formed into balls, known as 'pellets' or 'rejects,' by the muscular action of the stomach and are regurgitated before a new supply of food is taken. The 'pellets' contain the skulls, teeth, and other parts of the victims, and furnish a perfect index to the food eaten. In a work on 'The Hawks and Owls of the United States,' published in 1893, I recorded the results of the examination of 200 'pellets' or 'rejects' of the Barn

Owl taken from one of the towers of the Smithsonian Institution, Washington, D. C., June 28, 1890. Since that time 475 more have been collected—125, September 14, 1892; and 350, January 8, 1896, making in all a total of 675 'pellets.' This abundant material has been carefully examined and found to contain the remains of 1821 mammals, birds and batrachians as shown in the following table:

1119	Meadow Voles (*Microtus pennsylvanicus*)
4	Pine Voles (*Microtus pinetorum*)
452	House Mice (*Mus musculus*)
134	Common Rats (*Mus decumanus*)
1	White-footed Mouse (*Peromyscus leucopus*)
20	Jumping Mice (*Zapus hudsonicus*)
1	Rabbit (*Lepus sylvaticus*)
33	Short-tailed Shrews (*Blarina brevicauda*)
21	Small Short-tailed Shrews (*Blarina parva*)
1	Star-nosed Mole (*Condylura cristata*)
1	Brown Bat (*Vesperugo fuscus*)
2	Sora Rails (*Porzana carolina*)
4	Bobolinks (*Dolichonyx oryzivorus*)
3	Red-winged Blackbirds (*Agelaius phœniceus*)
1	Vesper Sparrow (*Poocœtes gramineus*)
10	Song Sparrows (*Melospiza fasciata*)
4	Swamp Sparrows (*Melospiza georgiana*)
1	Swallow (*Petrochelidon*)?
1	Warbler (*Dendroica*)
6	Marsh Wrens (*Cistothorus palustris*)
2	Spring Frogs (*Rana pipiens*)?

A glance at this list will demonstrate to any thoughtful person the immense value of this useful bird in keeping noxious rodents in check. Moreover, judging from the species in the list, it may be seen that the barn owl hunts almost exclusively in open country, such as cultivated fields, meadows and marsh lands, where such pests do most damage. In Germany, according to Dr. Bernard Altum (Journal f. Ornithologie, 1863, pp. 43 and 217) the barn owl feeds extensively on shrews. In 703 'pellets,' a number only slightly greater than that which I examined, he found remains of 1,579 shrews, an average of over two to each 'pellet,' while our 675 'pellets' contained only 54 shrews, an average of one skull to every 12½ pellets. On the other hand our material contained the remains of 2½ mice to each 'pellet,' or 93 per cent. of the whole mass. The birds, which constitute about 4¾ per cent. of the owl's food, are in the main species of little economic importance.

A. K. Fisher.

CURRENT NOTES ON ANTHROPOLOGY.

THE ETHNOLOGY OF TIBET.

A valuable article on this subject is published in the last report of the National Museum (Washington, 1895), prepared by the experienced traveler, Mr. W. W. Rockhill. It describes the social customs, dress, habitations, agriculture, food, music, money, religion, etc., of the Tibetans with much minuteness.

Their civilization was demonstrably obtained either from India or China, those who may be styled the indigenous inhabitants contributing very little to it. These indigenes are now best represented by the scanty and semi-nomadic population of the northern plateaux, which rise to an average altitude of more than 15,000 feet above the sea level. They are known as 'Drupa,' and although they belong to the same linguistic family as the Burmese they are more remote than these from the physical type of the Mongols. The hair, instead of being straight, is wavy, the eyes brown or hazel, the nose often narrow and not much depressed at the root. The skin is frequently nearly white and the cheeks rosy, though on exposure the complexion may become a dark brown.

These traits present a physical type quite dissimilar from that which ethnographers term the Mongolian.

RESEARCHES IN AMERICAN ARCHÆOLOGY.

The twenty-ninth report of the Peabody Museum of Archæology and Ethnology, at Cambridge, Mass., is brief, covering but nine pages, but contains a number of inter-

esting references to the researches in which the institution is engaged.

The most noteworthy relates to the exploration of the ancient city of Copan, Honduras. A wonderful stairway has been discovered, twenty-four feet in width, and leading to the summit of a pyramid over one hundred feet in height. It is built of massive blocks of stone, the front of each of the steps being covered with deeply-cut hieroglyphs and delineations of the human form. When once restored and copied, we may indeed find on it, as the report says, "the most important hieroglyphic inscription in Central America."

A curious addition to the Museum is the only ancient New England bow in existence. It is five feet seven inches in length, being much longer than has generally been stated. The Hemenway collection from the Salt River valley has been deposited in the Museum by the executors and arranged by Dr. J. Walter Fewkes. About twelve students are studying in the department under the direction of Professor F. W. Putnam and his assistant, Dr. Dorsey.

THE ALLEGED TERTIARY MAN OF BURMAH.

CONSIDERABLE attention was attracted early last year by the assertion of Dr. Noetling, repeated in various periodicals, that he had discovered in a miocene layer, on the banks of the Irrawadi river, rude flint implements of 'palæolithic' patterns. Later in the year he announced that the strata were not miocene, but certainly pliocene, and therefore tertiary man was still saved.

Another geologist, Mr. Oldham, in *Natural Science*, September, 1895, questioned the occurrence of the flints in the original deposit. It appears that the face of the outcrop has a veneer of mud washed down from the super-incumbent strata, adherent to its ferruginous surface, and that the chipped flints are found in this coating. Just such 'implements' are scattered over the plateau above, and would naturally be washed down with the surface soil in heavy rains.

This demonstration seems to relegate the Burmese find to that region of extreme doubtfulness in which at present every alleged discovery of tertiary man in Europe or America rests.

RACIAL DEGENERACY IN AMERICA.

A WELL prepared article on this subject is contributed to the *University Medical Magazine*, January, 1896, by Dr. Albert S. Ashmead. He reviews the prevalence of goitre, cretinism, leprosy and dwarf stature in America as factors in ethnic physical and psychical degeneration. In his survey he includes the native as well as the immigrant American and African races, and collects a large amount of references on the subject. On the whole, it cannot be said that he has shown any special tendency of humanity in the New World to retrogressive transformation or racial pathology. The causes to which he alludes are frequent in the other continents with like effects.

What would be especially desirable in this direction would be a study of the white race in the United States in isolated localities where its members have been subjected to the environment for a hundred years or more with little access of crossings from without. Undoubtedly, important modifications have taken place, but they have not yet been critically collected.

PSYCHOLOGICAL NOTES.

THE SENSE OF EQUILIBRIUM.

INTERESTING experiments are reported in the *Biologisches Centralblatt* by Bethe on the connection between the sense of equilibrium and the semi-circular canals. He finds that doves are not well adapted to exhibiting this connection; he allows dead doves with their wings distended by wires, to fall

through the air, and finds that the structure of the body is such that equilibrium is preserved, and is even recovered if the body is started half way over. Hence these birds, if active, can still often fly reasonably well after the semi-circular canals have been extirpated. But the case is very different with fishes, and they, consequently, exhibit the usual effects of mutilation very perfectly; after total extirpation of the labyrinth on both sides, they swim with complete oblivion of the attitude proper to the fish in water. The author also believes that some fishes at least learn to guide themselves by their labyrinth sense only after some experience. The subject is one of great interest, and this paper is a distinct contribution to our knowledge regarding it.

C. L. F.

THE PHYSIOLOGICAL CONCOMITANTS OF SENSATIONS AND EMOTIONS.

The first issue of the *Journal of Experimental Medicine* contains an experimental research from the Physiological Laboratory of John Hopkins University by Dr. T. E. Shields on the effects of odors, irritant vapors and mental work upon the blood flow. The author regards his chief results to be improvements in Mosso's plethysmograph. With this instrument changes in the volume of the arm are measured and it is assumed that the blood withdrawn from the arm is called to the brain as a result of mental activity. The apparatus is complicated and Dr. Shields has used great care in eliminating various sources of error. He finds that odors and mental work cause (presumably) congestion of the brain. Even when the volume of the arm is at first increased, this is due to the acceleration of the heart rate, which would also tend to increase the supply of blood to the brain. Dr. Shields' experiments contradict Lehman's view that pleasant sensations decrease the blood supply to the brain. The article is admirably illustrated.

Dr. F. Kiesow, in a paper (*Philos. Studien*, XI., 1) not referred to by Dr. Shields, has used Mosso's new sphygmomanometer for similar purposes. With this instrument the pressure of the blood in two fingers is measured. Strained attention, mental operations, such as multiplying, sudden noises, sudden pains, etc., were used. The results were varied and difficult to interpret. Sometimes there was no alteration in pressure, sometimes there was a decrease, but more commonly an increase. Dr. Kiesow concludes that the alterations are not due to the sensations nor to the attention as such, but to the feelings that accompany them.

In an extended investigation (*Philos. Studien* XI., 1, 3 and 4) Dr. Paul Mentz has studied the effects of sounds on the pulse and on breathing. A single noise or tone of moderate intensity caused a slower pulse and usually a slower rate of breathing, which the author attributes chiefly to the pleasure accompanying the sensation. If the sounds are intense or long continued the pulse becomes quickened. When music was listened to passively the rate of the pulse was decreased, but it was quickened when the attention was strained.

J. McK. C.

SCIENTIFIC NOTES AND NEWS.

THE ACTION OF THE HOUSE OF REPRESENTATIVES ON THE METRIC BILL.*

The Hon. C. W. Stone, Chairman of the Committee on Coinage, Weights and Measures, received notice on Tuesday afternoon, April 7th, that he would be given an opportunity to call up at once the Committee's Bill in regard to fixing the standard of weights and measures, according to the Metric System of weights and measures. The hour was late, but Mr. Stone promptly made his argument in favor of the Bill, Mr. Stone's speech was a thorough and

* Based upon the report of the correspondent of the New York Dry Goods Economist.

comprehensive discussion of the proposed change, preceded by a historical sketch of the origin of the system, He quoted the prediction made by the Hon. John A. Kasson in reporting the bill in 1866 to the House, that a subsequent House would make, at a not-distant date, exclusive and compulsory the measures then simply legalized. He cited the strong indorsements which the system has received from the late Secretary Blaine, Postmaster-General Wilson, Secretary Caslisle, The Director of the Mint, the Superintendent of the Coast and Geodetic Survey, etc., and dwelt at some length on the letter of the Hon. J. S. Morton, Secretary of Agriculture. He discussed also the magnitude of our commercial relations with Metric-using countries and showed the ease with which the system had been adopted by different peoples. He cited the British Consular reports, showing Great Britain's loss through retaining her old and awkward systems, and explained the present progress toward the Metric System by the three remaining non-Metric countries, the United States, Great Britain and Russia.

Mr. Stone's speech was very well received, and it was first thought that a vote would be taken without debate. Mr. Bartlett, of New York, however, secured the floor and made a short speech in opposition to the bill. He was followed by Representative Otey, of Virginia, who made a humorous speech against the Metric System, dwelling chiefly upon the Metric terms. Mr. Hurley, of Brooklyn, replied in a dignified manner to Mr. Otey's effort and suggested that in the hands of a humorist our present system could be made very ridiculous. After more discussion Mr. Stone called for a vote, and on a division of the House there were 65 votes in the affirmative and 80 in the negative. The vote being less than a quornm, Mr. Stone succeeded in securing an adjournment, and the fight went over until Wednesday morning, when the yeas and nays were ordered. After the experience of the day before, Mr. Stone was anxious to gain time, believing that it was only necessary to acquaint the members further in regard to the system under more favorable conditions than those of a noisy debate in the House, to secure the passage of the bill; but a vote could not be avoided, and when the announcement was made that the bill had passed by a vote of 119 to 117 a shout of applause went up from the floor and galleries. Those who had opposed the bill, however, took courage, because of the narrow majority in favor of the bill, and promptly moved a reconsideration. Upon this motion yeas and nays were ordered and the opponents of the bill went vigorously to work to change votes, with the bugaboo of the angry farmer protesting against being tangled up with a new system of weights and measures on the eve of a Congressional election. The result of this work was soon apparent. Mr. Hurley's motion to lay the motion to reconsider on the table was lost by a vote of 136 to 111, and the motion to reconsider prevailed by a vote of 141 to 99. Mr. Stone's only remaining chance was to ask to have the bill recommitted to his Committee. This motion was carried *viva voce*.

After the battle in the House many members who had voted against the bill expressed themselves as not being opposed to it for any reason except that they did not understand it; while others did not hesitate to say that it would be a very easy thing to put through after election. A Western member voiced the sentiment of many of his colleagues in a paraphrase of one of Mr. Otey's witticisms, saying: "If I should talk to my farmers about kilograms they would kill me next November."

The campaign for the introduction of the only enlightened system of weights and measures known to the world will go on unchecked, and sooner or later the United States will follow the other nations of the earth in its adoption.

THE NEW EDINBURGH OBSERVATORY.

THE new Royal Observatory at Edinburgh was opened on April 7th by an inaugural ceremony in which Lord Balfour, Lord Crawford and Sir Robert S. Ball took part. Edinburgh has long had a fairly well equipped observatory, but several years ago the Earl of Crawford presented his fine collection of instruments to the observatory, and as there was not room to use these properly a government grant amounting to £36,000 was secured for a new building. The building and its equipment are said to be much superior to any other in Great Britain,

though they do not compare favorably with the great American observatories. According to the description in the London *Times*, the buildings consist of the observatory proper, the official residence of the Astronomer Royal, the residence of the assistant astronomers and subsidiary buildings. The Observatory is a T-shaped building, the head of the T facing the north with a frontage of 180 feet, and having at each end a telescope tower, of which the eastern is 75 feet high and 40 feet in diameter, and the western is 44 feet by 27 feet. The former contains the most important instrument in the observatory—a new refracting telescope of 15-inch aperture. The latter contains the reflecting telescope, removed from the Calton observatory, which has an aperture of 2 feet, and which is to be used in astro-physical researches. From the western tower a sloping gangway leads upwards to the transit house, in which is a telescope of 8½ inch diameter resting on a horizontal axis. Connected with the Observatory, there are a well-equipped photographic laboratory, and a library with accommodation for some 30,000 volumes, which is already well furnished with the Dun Echt collection.

The director of the Observatory is Mr. Ralph Copeland, Astronomer Royal for Scotland and Professor of Astronomy in the University of Edinburgh.

OCCURRENCE OF THE NATIVE WOOD RAT AT WASHINGTON, D. C.

THE Alleghany Wood Rat, *Neotoma pennsylvanica*, inhabits the Alleghany plateau from the mountains of North Carolina to southern New York. In Virginia it is known to occur at several localities in the Blue Ridge Mountains. Recently, in trapping among the rocky cliffs along the west side of the Potomac River, four miles above Washington and a quarter of a mile from the old boundary line of the District of Columbia, I secured five of these rats. They are fairly common at this point, which they doubtless reach by following the river cliffs from Harper's Ferry, where the Potomac cuts through the Blue Ridge. No doubt they come a little farther down, probably to the end of the high ridge opposite Georgetown.

The rats were caught under masses of broken rock and in clefts and caverns in the ledges, where their nests, stick piles and runways may be seen by any one who will take the trouble to look for them. VERNON BAILEY.

GENERAL.

THE French Association for the Advancement of Science met at Tunis during the first week of the present month. M. Paul Dislère, in his Presidential address, reviewed navigation on the Mediterranean, beginning with ancient Carthage. M. de Bort, the Secretary, according to custom, described the previous meeting at Marseilles, losses by death, and honors conferred on members. M. Galante, the Treasurer, reported receipts for the current year amounting to 99,661 fr. and a reserve fund amounting to 1,190,100 fr. The meeting next year will be at St. Etienne.

THE American Medical Association, in conjunction with the American Academy of Medicine and other associations, meets this year at Atlanta, beginning on May 2d. Many papers and discussions, interesting not only to members of the medical profession, but also to other men of science, are announced.

AN examination of the recently published list of the *Deutsche chemische Gesellschaft* reveals some interesting statistics. Out of 3,020 members, 1,274 are from foreign countries. Of these the United States stand first with 261, and the United Kingdom a close second with 236. Then follows Austria, 175; Switzerland, 145; Russia, 124; France, 76; Holland, 75; Italy, 67, and Sweden, 28. Belgium, South America, Denmark, Japan, Norway, Finland and the East Indies follow with between five and ten; Canada, India, South Africa, Portugal, Roumania, Bulgaria, China, West Indies, Spain, Servia, Greece, Australia, New Zealand, Mexico, East Roumelia, Persia and Palestine are represented, the last four by a single member each. The Society might with justice claim to be international. Turkey is the only country in Europe with no member.

THE *Société Nationale d'Horticulture de France* will hold an international exposition from May 20–25, 1896. During that period an Inter-

national Horticultural Congress will also be held to which the correspondents of the Society are invited to send delegates. Correspondence should be directed to M. Ernest Bergman, Secretary of the Commission for the organization of the Congress, 84 Rue de Frenelle, Paris.

AT the Berlin Industrial Exhibition to be held from the 1st of May to the 15th of October of the present year, there will be an international exhibition of astronomical photographs. Astronomers are requested to send to Dr. F. S. Archenhold, astronomer of the Grunewald Observatory, photographs, drawings of astronomical instruments and other objects suitable to the exposition. Dr. Archenhold will exhibit the new refracting telescope of the Grunewald Observatory, which is said to be the largest in Germany. This has two objectives, one of 170 and one of 110 cm. Instead of the usual dome, this telescope is provided with a cylindrical cover.

IT is announced that Prof. Schafer, of University College, London, is editing a text-book of physiology which will contain contributions by Professors Halliburton, Gamgee, Burdon Sanderson, Gaskell, Langley, Sherrington, McKendrick, Haycraft and others.

THE Swiss National Exhibition, which will be held at Geneva from May 1st to October 15th, will be especially noteworthy for the electrical exhibit, which, it is said, will be the finest ever made. Mr. Theodore Turretine, the Mayor of Geneva and President of the Exposition, is himself an electrical engineer.

THE Natural History Museum of London has acquired by purchase the collection of fossil bird remains from the reputed 'Eocene' beds of Santa Cruz, Patagonia, formed by Dr. F. Ameghino, of La Plata.

THE Pennsylvania Forestry Association held an unusually successful meeting at Philadelphia on April 10th. Addresses were made by Governor Hastings, Mayor Warwick, Provost Harrison, Mr. Fernow and Dr. Rothrock.

THE American Metrological Society is sending out a great many metric charts, pamphlets, petitions, etc., for the purpose of educating the people in regard to the salient points of the metric system, and those who understand the system are requested to write to their Representatives in Congress, urging them to vote for the Committee's Bill, a copy of which was published in this JOURNAL on March 27th.

IN a speech before the Senate in behalf of the bill providing for an additional fire-proof building for the U. S. National Museum, Senator Morrill stated that while the proposed building would suffice for the present to exhibit the accumulated specimens another and more elaborate building would be ultimately found necessary.

DR. WILLIAM SHARP, F. R. S., died at Llandudno, Wales, on April 10th, being 91 years of age. Dr. Sharp aided in the introduction of the teaching of science in schools and in the establishment of local museums throughout Great Britain. We regret also to record the death of Prof. Justus M. Silliman, for twenty-five years professor of mining engineering at Lafayette College, and of Dr. Charles Human, the German engineer and archæologist.

THE *British Medical Journal* states that the late Dr. W. C. Williamson, professor of botany at Owens College, Manchester, whose collection of specimens has just been purchased by the British Museum, left behind him an autobiography, which Mr. George Redway is about to publish under the title of 'Reminiscences of a Yorkshire Naturalist.'

MR. SEWELL has introduced into the United States Senate a bill providing for the establishment of a military and national park on the Palisades of the Hudson and making a preliminary appropriation of $500,000 for the purpose. The States of New York and New Jersey have agreed to cede jurisdiction over the Palisades to the United States.

THE French Geographical Society has awarded a gold medal to Dr. Louis Lapique for his voyage along the coast of Beloochistan and in the Persian Gulf, and more especially for his ethnographical researches on the Negritos.

THE *British Medical Journal* states that M. Renier has bequeathed to the Belgian treasury the sum of two million francs, to be applied to the foundation of a medical institute to be called the 'Institut Rommelaere.'

THE first serious treatment of American Mallophaga, or bird lice, is found in a paper just published conjointly by the Leland Stanford University and the California Academy of Sciences. In this paper Prof. V. L. Kellogg gives a table and synopsis of the genera and describes one new genus and 38 new American species, besides identifying 22 species previously described by European authors, but here, with few exceptions, first determined as parasites of American birds. For the first time in any work close attention is paid to immature forms as a contribution toward their almost unknown life history, and about 80 complete figures of bird lice are given, besides others of details of structure or portions of the body. It is sure to stimulate further investigation in a much neglected field.

A SERIOUS landslide is reported to have taken place at Trub, twenty miles east of Berne. A landslide is also said to have taken place at Bondesir, Saguenay county, Quebec.

PROF. W. WUNDT has been elected foreign associate and M. J. Lachelier member of the Paris *Institut* (Academy of Medical and Political Sciences).

THE provisional program of the International Congress of Psychology, to be held at Munich from the 4th to the 7th of August, announces 102 papers, and others will be announced later.

FELIX ALCAN announces as in press *La psychologie des sentiments* by Prof. Ribot and *Les types intellectuels* by Prof. Paulhan.

THE epidemic disease afflicting well meaning but ignorant people and leading them to see visions somewhat similar to those occurring in *delirium tremens* is not confined to America. A memorial with some 12,000 signatures has been presented to the Home Secretary of Great Britain and Ireland, claiming that there is not sufficient inspection under the act relating to vivisection. They state that two licensees had exceded the rights given them by their certificates.

ON April 5th, the first Sunday that the London National Museums were open to the public, there were 7,138 visitors at South Kensington Museum and 3,026 at Bethnal Green Museum.

DR. LEWIS SWIFT, of Lowe Observatory, California, has discovered a new comet. It is stated that its position was: Right ascension, 3 hours, 38 minutes and 26 seconds; declination, 18 degrees, 19 minutes, 32 seconds north on April 16th, 0.6896 Greenwich mean time. The comet is moving north at the rate of $2\frac{1}{2}$ degrees per day and very slowly westward. It is about as bright as a seventh magnitude star, and has a decided condensation in its head and a short tail.

DR. CH. WARDELL STILES, of the U. S. Department of Agriculture, has been elected a member of the French Academy of Medicine.

PROF. SEELEY, F. R. S., will begin a summer course of lecture excursions with the London Geological Field Class at the end of April. The subject of the series will be 'The Physical Geography and Geology of the Thames and its Tributaries.' This is the 11th annual course.

THE Boston Aëronautical Society, wishing to circulate its notices and reports, requests all those who are in any way interested in aërial navigation, to place their names on file, addressing the Secretary of the Society, Box 1197, Boston.

THE *Progressive Age* has published a report on experiments carried out by Prof. E. J. Houston and A. E. Kenelly to determine the actual cost of producing carbide of calcium at the works of the Wilson Company, at Spray, N. C.

WE learn from *The Lancet* that the Dean and Faculty of the Medical School of University College, Bristol, having consented to receive and permanently locate the valuable collection of momentos of Edward Jenner, known as the 'Jenner Relics,' it is desired to raise by public subscription the sum of £1,500 in order to defray the cost of purchase from Mr. Frederick Mockler, of Wotton-under-Edge. Each subscriber of one guinea and upwards will receive when the list is complete a silver medal, and to subscribers of not less than half a guinea a bronze medal will be presented, commemorative of the Jenner Centenary, May 14, 1896.

IN the summary report of the Canadian Geological Survey, Mr. Dawson calls attention to the entirely insignificant accommodation afforded by the present building for the work of the Survey. Not only are the offices inade-

quate and inconvenient, but the space available in the museum has become much too restricted, while both offices and museum, with all their valuable accumulations, are subject to danger of loss by fire. The advantage to Canada of having an adequate display of the mineral wealth of the country can scarcely be exaggerated, and that the museum, even in its present state, possesses much interest to the general public, is evidenced by the fact that more than 26,000 visitors have been registered during the year.

UNIVERSITY AND EDUCATIONAL NEWS.

YALE UNIVERSITY receives $200,000 through the marriage of Mrs. T. C. Sloane. Mr. Sloane had left part of his estate as a trust fund, the above amount to go to Yale University in case of Mrs. Sloane's second marriage.

THE will of the late Ephraim Howe leaves $40,000 to Tufts college for a new building to be known as the Howe memorial.

THE New York *Evening Post* states that the library of Cornell University has secured, by purchase, through the Sage endowment fund, the extensive collection of works on South America gathered, mainly during an eight years' residence in Brazil, by Herbert H. Smith, of the Brazilian Geological Commission.

IT is understood that Edinburgh University will receive £20,000 from the estate of the Earl of Moray as an endowment fund for the promotion of original research in the University.

THE Senate of the Glasgow University has conferred the degree of D. D. on Prof. Thiselton-Dyer and on Prof. Andrew Gray.

THE St. Petersburg Medical Academy has received from the Russian government $2,500 for experiments with the X-rays.

DISCUSSION AND CORRESPONDENCE.

CERTITUDES AND ILLUSIONS.

EDITOR OF SCIENCE: I am very much afraid that physicists will find themselves utterly unable to follow, or, at least, to understand, Major Powell in his philosophical dissertations on the fundamental concepts of mechanics, and that they will be compelled to conclude that his philosophy is *not* 'Natural' Philosophy, in the generally accepted sense.

Believing this to be inevitable, it is hardly worth while to continue at any length a discussion or critical examination of the very interesting propositions which he has laid down. It may be of use, however, to invite his attention to the fact that in the answers to my questions relating to 'Rest and Motion,' which he gave in this JOURNAL for April 17th, he continues to ignore entirely the only serious issue raised by them. It can hardly be supposed that Major Powell is undertaking to establish a concept of motion independent of relativity, yet he seems to overlook the necessity of giving it consideration. When, in answer to my question, he defines motion as 'change of position' it only leaves the question where it was before, if not in even greater obscurity. 'Position' implies a relation; then motion implies a relation and cannot be predicated of any one of Major Powell's several orders of units.

His statement that "the speed of a particle is constant in reference to itself at different times" is meaningless, if the commonly accepted idea of motion is correct. If it is not correct, and that of Major Powell is, then—the bottom has dropped out.

As to his suggested correction of a typographical error in his previous statement relating to the velocity of light, if *molar* be substituted for *molecular* in that statement, it remains quite as astounding as before. I mention this only that he may note that apparently he has not detected the real absurdity involved. M.

APRIL 19, 1896.

IS THERE MORE THAN ONE KIND OF KNOWLEDGE?

"My praise shall be dedicated to the mind itself. The mind is the man, and the knowledge of the mind. A man is but what he knoweth. The mind itself is but an accident to knowledge, for knowledge is a double of that which is. The truth of being and the truth of knowing is all one."—Praise of knowledge.

I am pleased to find in the current number of SCIENCE (April 3, 1896), that after seven months

of irrelevant discussion on side issues, one of your readers (M. M.), has at last found the thesis of my article on Science and Poetry (Science Oct. 4, 1895,) worthy of consideration.

While I take issue with M. M., I thank him for this opportunity to give, once more, my reasons for the belief that is in me that there is only one kind of knowledge and but one way to acquire it.

I hope I may be permitted to say, in introduction, that I have no sympathy with those who hold that science is inductive or nothing. I yield to no one in reverence for mathematics. I wish it had been my good fortune to be more familiar with the deductive or 'abstract' sciences, for I believe they are the best products of the human mind. I am prepared to stake everything on their axioms, for I believe they are ἄξιοι, or worthy of all confidence. I accept the logical deductions from them as the best and most trustworthy of all knowledge.

All this is quite a different matter from the admission that these axioms rest on anything but evidence; that they are 'necessary;' or that we have any way to deduce new truth from them except the employment of that empirical *logic of events*, which is based on evidence and knowledge of the order of nature. I am acquainted with no evidence that the mind is anything more than 'an accident to knowledge,' or that knowledge is any thing but 'the double of that which is.'

In his comment on my assertion that *the test of truth is evidence* and nothing but evidence, M. M. admits that evidence is a requisite test for *nearly all* truths. I infer from this qualification that he believes there are some truths for which evidence is not necessary.

If this means that some truths are already supported by so much evidence that no more is needed, I have nothing to say; but I take it that he believes with Hume, that certain truths 'are discoverable by the mere operation of thought, without dependence on what is anywhere existent in the universe.'

His words are not very explicit; and if this is not his meaning I beg his pardon, and I ask leave to address this communication to those readers of Science, if any there be, who do believe in 'necessary truths.'

Like most students of the order of nature, I feel my own unfitness to contend in argument with one trained in dialectic, and I shall, therefore, attempt no more than a brief statement of what I believe to be the opinion of most of my scientific contemporaries concerning those conceptions which are called axioms, innate ideas, intuitive beliefs or necessary truths.

When we ask proof that these conceptions are innate we get no direct evidence, but we are told we must admit this, since we cannot conceive their contrary. As M. M. acknowledges that 'inconceivability is no test of falsity,' he, at least, cannot make this reply; for, if his words mean anything they mean that inconceivable things may be true. We have no way to discriminate between unknown things, and anything which may be true may some time prove true.

If there were any reason to believe the human mind is a finished instrument, perfect, and a measure of the unknown, the argument, that these beliefs are necessary because we cannot conceive their contrary, might seem valid; but no one who believes 'the subtilty of nature is far beyond that of sense or of the understanding' can admit that this proves they are necessary in any sense of the word except the practical one. We are able to spin fancies out of our minds as a spider spins silk out of its stomach, but I hope most readers of Science agree that "all this is but a web of the wit; it can work nothing." I hope they agree, also, that the difference between truth and fancy is evidence.

We say, glibly enough, of this quintessence of dust: "What a piece of work is man? How noble in reason! how infinite in faculties! in apprehension how like a god!" But it is perhaps fortunate for our self esteem that we have no opinion on the subject by any competent judge; and it is the height of folly to attempt to measure the unknown by our own minds.

We are told, furthermore, that reasoning is impossible unless these 'necessary' truths are admitted, and that, if they should ever cease to hold good, the result would be madness and destruction. This may be true, for all I know, but if the human race is ever overwhelmed in

this way it will not be the first, for the rocks are filled with the remains of races which have been destroyed because their internal adjustments failed, at last, to correspond to the order of nature, after a long period of more or less perfect agreement.

There is no direct evidence that the conceptions in question are innate. The indirect evidence from the inconceivability of their negation is worthless, because of the imperfection of our minds. The statement that thought is impossible without them is no assurance that our race may not, like many races which have gone before, some time find itself where the old order changes. Finally the modern student finds still a fourth reason for questioning the necessity of these ideas; the fact that evidence is adequate to account for them, and that the assumption that they are innate is unnecessary.

"It is impossible to prove that the cogency of mathematical first principles is due to anything more than these circumstances; that the experiences with which they are concerned are among the first which arise in the mind; that they are so incessantly repeated as to justify us, according to the ordinary laws of ideation, in expecting that the associations which they form will be of extreme tenacity; while the fact that the expectations based upon them are always verified finishes the process of welding them together. Thus, if the axioms of mathematics are innate, nature would seem to have taken unnecessary trouble, since the ordinary process of association appears to be amply sufficient to confer upon them all the universality and necessity which they actually possess."

Your correspondent M. M. complains that my assertion, that the only test of truth is evidence, gives him 'a slight feeling of dizziness,' as if it were something radical and revolutionary. He may be interested to know that about 2500 years ago Heraclitus warned his fellowmen of the danger of seeking truth in their own little worlds instead of the great and common world, while Bacon gives more energetic expression to the same conviction in the following words:

"This is a rotten and pernicious idea or estimation that the majesty of man's mind suffers diminution, if it be long and deeply conversant with experiences. * * And this opinion or state of mind received much strength from another *wild and unfounded* opinion, which held that truth is innate in the mind of man and not introduced from without, and that the senses rather excite than inform the understanding."

Most students of the principles of science admit that the mind of man has not yet attained to knowledge of causes, but that it has, so far, discovered nothing except a little of the order of nature. The reason why events, either mental or physical, occur in one order rather than another is a mystery which is absolutely unsolved. We can say no more of them than that "they appear together, but we do not know why."

If this is true it is clear that we are in no position to say of any event that it *cannot* be true in the absence of any other event. "The distinction between the necessary and the sufficient condition for the truth of a statement," which M. M. seeks to establish, has therefore no warrant in our knowledge of nature; for while we may seek to 'govern nature in opinion we are thrall unto her in necessity.'

Whether there be such a thing as *formal* logic, distinct from the empirical logic of events, or not, I believe my associates are pretty well agreed that all attempts to make practical application of formal logic have ended in failure. "The two ways of contemplation are not unlike the two ways of action commonly spoken of by the ancients; the one pleasant and smooth in the beginning and in the end impassable, the other rough and troublesome in the entrance but after a while fair and even. So it is in contemplation; if a man will begin with certainties, he shall end in doubts, but if he will be content to begin with doubts he shall end in certainties.

"Once on a time there were two brothers. One was called Prometheus, because he always looked before him and boasted that he was wise beforehand.

"The other was called Epimetheus, because he always looked behind him and did not boast at all, but said humbly, like the Irishman, that he would sooner prophesy after the event.

"Well, Prometheus was a very clever fellow, of course, and invented all sorts of wonderful things, but, unfortunately, when they were set to work, to work was just what they would not

do; wherefore very little has come of them, and very little is left of them; and now nobody knows what they were, save a few archæological old gentlemen who scratch in queer corners.

"But Epimetheus was a very slow fellow, certainly, and went among men for a clod, and a muff, and a milksop, and a slow coach and a bloke, and a boodle, and so forth. And very little he did for many years; but what he did he never had to do over again. Stupid old Epimetheus went working and grubbing on, always looking behind him to see what had happened, till he really learned to know now and then what would happen next, and understood so well which side his bread was buttered, and which way the cat jumped, that he began to make things which would work, and go on working too, till at last he grew as rich as a Jew and as fat as a farmer, and people thought twice before they meddled with him, but only once before they asked him to help them." W. K. Brooks.

April 8, 1896.

THE RETINAL IMAGE ONCE MORE.

I rejoice to learn, in the current number of Science (April 3, 1896, p. 517), that C. L. F. does not include me with the '*Medical Society in Philadelphia*,' and the '*Prominent Baltimore Physician*,' among those '*Distinguished Scientists who think there is anything which needs explanation in the fact that the image on the retina is inverted*;' but as I know no reason why the readers of Science should rejoice with me, I do not care to dwell on the matter.

W. K. Brooks.

ON THE DISAPPEARANCE OF SHAM BIOLOGY FROM AMERICA.

Almost exactly three years ago I contributed to Science* a paper entitled 'On the Emergence of a Sham Biology in America.' In this article I found it necessary to criticise severely the condition of things in some of the leading American universities where courses in zoölogy were permitted to masquerade under the larger title of *Biology*. I protested vigorously against the educational deception which, in at least one important institution—where the official announcement was made that only lack of funds prevented a proper development of botanical science—attempted to cover up this poverty by naming the courses in zoölogy courses in 'biology.' It was pointed out that much harm was done to true biological science by such ignoring of one-half of the science and professing that the moiety remaining was the whole.

Following this article of three years ago was a great outcry against my position from gentlemen professing to represent Johns Hopkins University and Columbia University in the columns of Science, but at the same time I received some half hundred letters of congratulation from both zoölogists and botanists, representing the leading institutions of the country from Harvard to California. In Science for May 26, 1893, I closed the discussion and waited for the outcome, for it was clear that attention to the matter had been excited.

Within a year Chicago University announced the withdrawal of its Department of Biology and the title of Dr. Whitman was changed from Head Professor of Biology to Head Professor of Zoölogy. Following this came the announcement of the creation of a Department of Botany at that institution, and one stronghold had fallen.

This year I learn that on March 2d the Trustees of Columbia University have changed the name of the Department of Biology to Department of Zoölogy, and have altered the titles of the staff to correspond. I am exceedingly gratified at this action which places Columbia upon the reasonable and honest basis. It now remains for the one important institution that is at the same time the greatest offender of all to awaken to its isolated and dishonest position and to cease sending out Doctors of Philosophy in Biology when the botanical work is still in the hands of a tutor and the preponderant stress is laid upon zoölogy. A full professorship of botany should be established at once, requiring no change in staff, but giving a fair recognition to both biological sciences and saving the institution from such spectacles as it had to witness three years ago when its 'biologists' stood up manfully for a sham biology that is now vanishing like mists in the morning.

Conway MacMillan.

* Science, Old Series, 21: 184. 7 Ap., 1893.

THE PREROGATIVES OF A STATE GEOLOGIST.

IT was with surprise that I noticed in a recent number of SCIENCE a communication on the 'Prerogatives of a State Geologist,' in which I am made the target of considerable unfair criticism. The temerity of its author, Mr. Erasmus Haworth, in distorting facts is not only a little astonishing, but smacks almost of deliberate endeavor to misrepresentation. Ordinarily it would not demand the slightest notice, but from the character of the presentation there might appear some plausibility to some of those who have no personal knowledge of the circumstances, of the animus of assault, or of the persons involved. I do not care to impose, even upon an indulgent public, an account of the various differences which have recently arisen between Mr. Haworth and myself. I only wish to make the statement, and that emphatically, that the charges made are either wholly false or are calculated to deceive. With the same data and by the same adroit manipulation of phrases and partial quotation it can be proved to the full satisfaction of the sunflower savant that the moon is made of green cheese. CHARLES R. KEYES.

COIN DISTORTIONS BY RÖNTGEN RAYS.

WE have repeated Professor Frost's interesting experiments on the distortion of coins (SCIENCE, N. S, Vol. III., No. 65, p. 465) in skiagraphs, but we have come to the conclusion that the distortion is due, not to electrostatic charges (as was suggested in the article referred to), but simply to umbras and penumbras formed by rays emanating from different points and falling upon coins of different thicknesses. In repeating Prof. Frost's experiments, we had the Crookes tube 14 mm. above the silver dollar and the film 3 mm. below the coins. We then placed the coins on a horizontal pane of glass and in the same position relative to the Crookes tube above them as when the skiagraph was taken. On holding a piece of paper up against the pane and examining by the eye, from below, the shadow cast by the coins in the light of the Crookes tube above, the very same distortion was seen that was shown in the skiagraph.

With the view of preventing X-rays having a large incident angle from striking the edges of the coins forming the curvilinear triangle, we placed upon the triangle a cylindrical section cut from the neck of a yellow-glass bottle. The section was ground down to a height of 11 mm., its internal diameter varied from 13 to 15 mm., its thickness was 5 mm. The distortion in the skiagraph was a trifle less than formerly, but more pronounced, we thought, than in the ocular test.

Fearing that the glass was somewhat transparent to X-rays, we replaced it by three iron washers superposed upon each other. Their internal and external diameters were 14 mm. and 34 mm. respectively, and their combined thickness was 9 mm. The tube, film and coins were in the same relative position as before. The skiagraph revealed much less distortion than in the first exposure. The ocular test with the washers on and with them off produced, as nearly as we could tell, exactly the same effects as were shown in the skiagraphs.

In another trial we discarded the washers and separated the coins from the film by only three thicknesses of black paper. The tube was again 14 mm. above the coins. As expected, the edges of the coins in the skiagraph were very sharp, and there was no trace of distortion. In this case the electrostatic charges must have been fully as pronounced as in the first experiment, but a perceptible penumbra could not have been formed. It would seem, therefore, that the distortion was due simply to umbras and penumbras cast by the coins.

FLORIAN CAJORI,
WILLIAM STRIEBY.

COLORADO COLLEGE,
April 10, 1896.

SCIENTIFIC LITERATURE.

THE ERUPTIVE SEQUENCE.

Die Eruptivgesteine des Kristianiagebietes II. Die Eruptionsfolge der triadischen Eruptivgesteine bei Predazzo in Südtyrol. Von DR. W. C. BRÖGGER. Videnskabsselskabets Skrifter, I. Mathematisk-Naturv. Klasse. 1895, No. 7. Kristiania.

After many years of exhaustive research

Brögger is now giving to science the results of his labors on the rocks of southeastern Norway in a series of memoirs of which the one before us is the second. Various preliminary papers and the classic monograph, *Die Mineralien der Syenitpegmatitgänge*, have stimulated petrologists to a keen anticipation of the magnificent contribution which should accrue to their science by the publication of Brögger's work. The first two memoirs amply justify these anticipations; and it is becoming apparent that the work will be an epoch-making event in the history of the science, and will result in the establishment, on a sure basis, of the principle of *magma differentiation* as one of the most important factors, if not the all-controlling factor in the genesis of rock types. Toward this principle, or rather toward a full comprehension of its scope, petrology has been groping rather vaguely for the last ten years, and we now seem to have arrived at a point when knowledge is beginning to crystallize from the all-pervading magma of ignorance. Among those prominent in contributing to the modern conception of differentiation Brögger is *facile princeps*, and it is fortunate for the science of petrology that a field so rich in possibilities of demonstration of the differentiation hypothesis should have fallen to the lot of so keen and masterful an investigator.

The subject-matter of the paper may be stated under the following heads:

1. The establishment of a new family of plutonic rocks, designated the *monzonites*.

2. A discussion of the eruptive sequence near Predazzo.

3. A discussion of the mechanism of plutonic eruption, involving

4. The proof of the laccolitic character of the plutonic rocks of the Christiania region.

5. A comparison of the eruptive sequence near Predazzo and Monzoni with that in the Christiania region.

6. The formulation and discussion of the law of plutonic sequence, involving

7. The discrimination between the sequence of plutonic and that of volcanic rocks.

A few words by way of summary and comment may be of service as indicative of the trend of thought in modern petrology.

The term monzonite has been used by different writers in various senses as a comprehensive and as a special designation for certain rocks occurring in the classic environs of Predazzo and Monzoni. The confusion arising from the various usages of the term is historically reviewed, and it is pointed out that, however various the usage, the rocks designated as monzonites have been, with one exception, by all writers, referred to the family of the Diorites, or plagioclase rocks, or to the Syenites, *i. e.*, orthoclase rocks. A review of the literature and of the rocks themselves leads Brögger to the view that the latter are properly to be classed with neither of these two families, but are characterized by approximately equal occurrence of both alkali feldspars and lime-soda feldspars. This being so, he claims for them recognition as a distinct family of plutonic rocks intermediate between those characterized by the prevalence of orthoclase (alkali feldspar) and those characterized by the predominance of plagioclase (lime-soda feldspar).

After an exhaustive review of the chemical characters of the monzonites and a discussion of their relations to other families of rocks, he formally defines them as an order of transition rocks between the orthoclase and the plagioclase rocks, of true plutonic character. They are of intermediate bacisity (SiO_2–49–62 per cent.), with a moderate lime contents (6–7 per cent.) and about the same contents of alkalies in equal proportion; high in alumina (17–18 per cent.) and relatively low in magnesia. Various subdivisions of the monzonites are recognized, such as *pyroxene-monzonite*, *hornblende-monzonite*, etc.

The establishment of the monzonites as a separate family of plutonic rocks as above defined is important in the emphasis which it places upon the inadequacy of the present scheme of classification to accommodate all rocks, and as expressive of a strong tendency among petrologists to expand the nomenclature.

The eruptive sequence near Predazzo and Monzoni is formulated as follows:

1. Oldest—Dykes and flows of basic rocks.

2. Corresponding to the latest of these are basic plutonic rocks.

3. More acid rocks—Monzonites, represented by volcanic flows of plagioclase porphyrite.

4. Biotite granite with contact facies of tourmaline granite.

5. Complementary dykes of camptonite and nepheline-bostonite-porphyry.

The discussion of the mechanism of plutonic eruption consists chiefly in a vigorous attack upon the 'assimilation hypothesis' of Michel-Lévy based upon its utter failure to explain the facts of the Christiania region. The assimilation hypothesis has much in common with a similar hypothesis put forward earlier by Kjerulf and involves the assumption that plutonic *massifs* have pierced the crust by a process of fusion of the region invaded and consequently of an absorption of a portion of the crust, thus explaining the common abutment upon these massifs of different stratigraphic horizons of the region invaded. Brögger combats this view, as it appears successfully, as applied to the Christiania region, and shows that the plutonic rocks have a laccolitic, and not a batholitic, relation to the Silurian strata which they invaded. This constitutes a very important advance in our conceptions of laccolites, the Christiania laccolite being by far the most extensive now known. The assimilation idea is disproved by the fact that although the igneous magmas invaded Silurian limestone, the analyses of the rocks show no enrichment of lime near the contacts; and the fact that the plutonic rocks transgress the ruptured edges of the Silurian strata, with the local absence of the lower members, is shown to be probably due to the fact that the latter underlie the laccolite and have not been absorbed by it. While the assimilation theory thus breaks down when applied to the Christiania region, it is by no means certain that it is not the true explanation of the origin of many other more extensive areas of plutonic rocks, as Brögger admits.

The essential features of the assimilation hypothesis were formulated by the reviewer some years ago, before the publication of Michael Lévy's views, and urged as a satisfactory explanation of the remarkable relations which obtain between the Laurentian granites and gneisses and the upper Archæan or Ontarian metamorphic rocks. These intrusive granites and gneisses occupy vast tracts of the Canadian Archæan plateau and there seems to be no escape from the view that they bear a batholitic relation to the crust which they invaded from below. Portions of the crust were absorbed, but there are two possibilities as to the method of absorption viz: 1. By fusion; 2. By sinking into the magma. The numerous blocks of rocks scattered through the granites lends much probability to the latter having played a part in the process. Such batholites were doubtless accompanied by laccolitic satellites.

In his comparison of the eruptive sequence in the Tyrol and Christiania regions Brögger finds an essential identity to the extent that the eruptive activity yielded first basic rocks, then those of intermediate acidity, then acid rocks and finally a reappearance of basic rocks in limited amount in the form of dykes.

The evidence bearing upon the sequence of plutonic eruption, drawn from the records of various well-known fields of geological research, is next placed in review and leads our author to the formulation of a general or normal law of sequence, which states, that plutonic rocks appear in any field in the order '*basic, less basic, acid.*' The sudden return to basic intrusions succeeding the acid is not sufficiently constant to warrant it being made part of so general a proposition. This law of succession is at variance with other attempts at the formulation of a general law, but all such former attempts have either been concerned with volcanic rocks solely, or have failed to discriminate between the volcanic and the plutonic. The necessity is urged of investigating the succession of these two classes of rocks separately. The discrimination will undoubtedly lead to an elimination of much of the confusion which exists in geological literature on these interesting questions.

In graceful compliment to American research, the volume is dedicated by its author to Prof. J. P. Iddings, of the University of Chicago.

ANDREW C. LAWSON.

BERKELEY, March 11, 1896.

Electric Wiring. By RUSSELL ROBB. Macmillan & Co., New York. 183 pp., 76 cuts. Price, $2.50.

This book is intended for the use of architects, underwriters and the owners of buildings.

In the first and second chapters the author explains, in a very clear manner and in a non-technical language, the properties of wires carrying currents of electricity. The particular features treated are those which have a bearing on danger from fire and the proper proportioning of wires to avoid such danger. Chapter III. deals with the series, the multiple and the three-wire systems. There are excellent diagrams showing what these systems are, and the text explains how they are operated. Chapter IV. gives a brief account of methods of wiring, particular attention being given to the reasons which make the conduit system the most desirable for the better class of modern buildings. The remaining chapter gives the National code of rules for wiring as applied to Central Stations, High-Potential Systems, Low-Potential Systems, Alternating Systems, Electric Railways and Batteries. These rules are all quoted in full, and each rule is followed by a full explanation of the reasons for its adoption and the dangers which it is the object of the rule to avert. The rules contain many technical words which are explained. It is evident that this is the kind of information which will conduce to the more general carrying out of these rules in practice. The house owner will see that they are designed to protect this property, and not simply to annoy him by useless restrictions. The book is well written and contains information that no house owner can afford to ignore if he is called upon to deal with electric wiring.

Francis E. Nipher.

SCIENTIFIC JOURNALS.

THE AUK.

The *Auk* for April is a number of rather more than usual interest. The opening article, by William Palmer, 'On the Florida Ground Owl (*Speotyto floridana*),' treats in detail of the peculiar distribution and breeding habits of this hitherto little known species, and is illustrated by a colored plate of the bird, a diagram of one of its breeding sites, and a cut showing in section one of its burrows. Mr. F. A. Lucas writes of 'The Taxonomic Value of the Tongue in Birds,' illustrated with figures of the tongue in 12 species, showing the relation of its structure to the food habits in different groups of birds.

Miss Florence A. Merriam has interesting 'Notes on Some of the Birds of Southern California,' and the well-known artist, Abbott H. Thayer, has a very suggestive paper on 'The Law which Underlies Protective Coloration,' with cuts in the text and five full-page photographic illustrations. In short, Mr. Thayer's newly discovered law is to the effect that 'animals are painted by nature, darkest on those parts which tend to be most lighted by the sky's light, and *vice versa*.' This is illustrated by a series of ingenious experiments with the Ruffed Grouse and Woodcock, showing that when the darker 'protective' tints of the upper surface are artificially extended over the lighter lower parts the bird becomes 'completely unmasked.' The artificial extension of the top colors over the lower parts destroys the counter-gradation of colors imposed by nature and forces the bird's solidity to manifest itself.

Dr. Louis B. Bishop describes a new Song Sparrow and a new Horned Lark from North Dakota, and George K. Cherrie a new Nighthawk from Costa Rica. Witmer Stone publishes a revision of the North American Horned Owls, describing also a new species. Some sixteen pages are devoted to a critical examination, by J. A. Allen, of Gätke's 'Heligoland as an Ornithological Observatory, the Result of Fifty Years' Experience'—a book that has attracted wide attention and in general has received high praise. Mr. Allen, however, shows that its merits have been often greatly overrated, and its faults either wholly overlooked or very leniently mentioned. While 'Heligoland' is an important contribution to the literature of ornithology, "it contains much that is set forth as fact which proves on close examination to be mere conjecture." This is especially true of Chapter IV., on the 'Velocity of the Migration Flight,' where, on very slight evidence and in opposition to an abundance of rebutting testimony, it is claimed that most birds perform under normal conditions their migratory journeys in 'one uninterrupted nocturnal flight, * * accomplishing a distance of at least 1,600 geographical miles within the space of nine hours.' He even considers that the Red Spotted Blue-

throat (*Cyanecula suecica*) may make the journey from Northern Africa to the Scandinavian Peninsula—a distance of 2,000 to 2,400 geographical miles—during a single May night, giving a velocity of four miles a minnte, or 240 miles an hour! The American Golden Plover, he affirms, migrates in autumn from Labrador to Brazil—a distance of 3,000 miles—in a single uninterrupted flight, going at an average rate of '212 geographical miles per hour.' As he offers nothing but negative evidence and conjecture in proof of these statements, they are scarcely entitled to serious notice, so contrary are they to all of the known evidence bearing on the case. In Chapter VI., on the 'Order of Migration According to Age and Sex,' the evidence in support of his thoory that "the autumn migration is initiated by the young birds, from about six to eight weeks after leaving the nest," does not well bear close analysis. But the worst portion of his book is the fourteen pages relating to 'Changes in the Colour of the Plumage of Birds without Moulting,' in which he asserts that the breeding dress in many birds is acquired by a change in the color of the feathers themselves without any alteration or change in their texture, whereby pure white feathers change to dark brown or black; and not only this, but the worn jagged edges of the old feathers at the same time are restored to their former size and evenly rounded outline, so as to look in reality like new feathers. As a matter of fact, the very species he cites and describes in detail as undergoing this wonderful process are well known to acquire their breeding dress by a spring molt! In view of these and other misstatements the review closes with the following: "With all its imperfections 'Heligoland' is a book of great interest and value, Part III. being a particularly useful contribution to the literature of ornithology. It is also a work that is likely to do much harm, for it is its sensational and inaccurate parts especially that find their way into the current literature of the day, and particularly into magazines and books devoted to the popularization of natural history."

The department of 'Recent Literature' contains the usual complement of reviews of leading works and papers on ornithology, and the department of 'General Notes' some thirty brief notices of rare or little known species, relating mainly to their occurrence at unusual or entirely new localities. Under the heading 'Correspondence' some ten pages are devoted to the discussion of various questions of nomenclature, by Witmer Stone, H. C. Oberholser and the editor, the number concluding as usual with several pages of 'Notes and News.'

SOCIETIES AND ACADEMIES.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON, MARCH 28.

MR. CHARLES RICHARD DODGE read a paper on some undeveloped American fibers. He stated that government experiments for the development of fiber industries in different countries date back nearly one hundred years. A necessity for such government aid is the importance of securing disinterested experts to prosecute the work, that the investigations and experiments may be conducted in a scientific manner. Such experiments relate to the testing of the strength of fibrous substances, the testing of new machines or new chemical processes for their preparation, and the cultivation of fiber plants when necessary to demonstrate their precise economic value.

In the United States 15 commercial fibers are recognized, only four of which are produced to any extent within our borders: cotton, hemp, palmetto and Spanish moss. The commercial forms not grown, but which might be produced in this country, are flax, jute, sisal hemp, New Zealand flax, cocoanut and possibly sunn hemp.

There are many other forms of plants, some of them classed as American weeds, which produce fibers known as jute or hemp substitutes, that it will not pay to cultivate while the standard fibers hold the market. These are chiefly bast fiber plants.

The flax industry is being reëstablished in this country, on the lines of an 'American practice' laid down by the Department of Agriculture, and gratifying progress has already been made in the new industry. Sisal hemp and some alleged forms of structural fiber plants will thrive in southern Florida. Ramie culture and the spinning and manufacture of the fiber are

no longer problems, though the world waits for a successful machine to clean the fiber for market.

There are many hundreds of fiber plants in the world, and the fiber expert is constantly asked to give information concerning the more promising species, not always with a view to cultivation, but often that useless expense in experimentation may be avoided through proper knowledge of their value. The question to be asked in considering a new form of fiber is not "Can we grow the species?" but "What commercial fiber will it compete with, or become a substitute for?" With a definite knowledge of the subject, as it relates to the fibers of the world, the expert need never be in doubt regarding the economic value of any species that may be submitted to him for an opinion.

The commercial fibers represent, in a sense, the survival of the fittest, and until these are crowded out by new conditions there is little chance for the other fibers, unless a particular species is found adapted to some new and special use for which the standard forms are not available.

The second paper was on *Geographic Names* by Henry Gannett.

BERNARD R. GREEN,
Secretary.

APRIL 11, 1896.

MR. S. P. LANGLEY read a paper on 'More recent observations in the infra-red spectrum.'

He referred to a communication to the Society more than two years ago, in which the expectation was held out of an early publication of a map of the infra-red spectrum made by the bolometer, and he desired to explain some of the difficulties which had caused its delay.

It was the misfortune of the astro-physical observatory here that appropriations for its maintenance were made in such a form that a proper building could not be erected in some site free from tremor, and under circumstances providing against local disturbance. As had already been stated in official reports, such local causes had introduced numerous errors in the record, in the form of tremors and oscillations in the photographic trace of the movements of the needle controlled by the bolometer, which it was almost impossible to exclude in the present installation. The linear spectra which had been shown here and before the British Association were all produced by a nearly automatic process, the minutest line in the spectrum implying a corresponding minuteness in the original curve; and in this connection he desired to call attention to the statement in a previous report, to the effect that all the minuter details, such as had been shown here and at Oxford, had not been verified; and to the fact that illustrations of the minuter detail in linear form were given at that time, with the caution that they were presented 'only in illustration,' and were 'not to be treated as a criterion of the final results.'

The amount of local error is roughly proportional to the minuteness of the detail sought. Thus, in the spectrum shown here, and later at Oxford, giving the leading lines discovered by the new method, nearly everything has stood the test of subsequent investigation; while of the minuter detail in the curves of which a linear translation was then given, in illustration of the process, a large proportion had been subsequently found to lie under suspicion.

The extent to which the character of the work had been influenced by these local conditions having been more and more recognized, the labor of the past two years had consisted largely in weeding out errors arising from them, and the process had involved the slow reconstruction or modification of nearly every portion of the apparatus, with special reference to the difficulties imposed by the site and the insufficient installation.

Details of the new apparatus were then given with lantern illustrations, particular attention being directed to the introduction of the system of suspending the galvanometer so that ground tremors were not conveyed to it, or were conveyed in diminished intensity, a change which was stated had been a most essential improvement, and which had done away, not entirely, but more than might have been thought possible, with the inconveniences of a site surrounded by city traffic.

Many bolographs had been taken during the past year, but only within the past months had the apparatus been brought to such a condition

that the local causes of error were diminished to a degree consistent with the desired standard of accuracy. In illustration of the difficulties overcome, it was stated that while a current passing through the bolometer is something like $\frac{1}{10}$ ampere, and while a current of less than $\frac{1}{1000}$ millionth part of this will cause a deflection of a millimeter on the scale, no such deflection was visible in the automatic trace shown in illustration. The bolometer was nearly as sensitive at the time of the last communication as it has been made since, and the work of the past two years has lain in guarding this sensitiveness against local causes of error, so that it shall be engaged in legitimate service, and respond only to a message from the sun. The speaker trusted that the final results of this labor would soon be made public, and concluded by renewing a statement of his obligation to those gentlemen who had been previously connected with the work, and by an expression of his indebtedness to Messrs. Abbot, Child and Fowle, who are associated with its present development.

MR. E. D. PRESTON read a paper on French, German and English systems of shorthand writing, in which he gave a brief review of shorthand writing from the time of the ancient systems down to the present day. The principles underlying the art were illustrated by examples from the French (Duployé) German (Gabelsberger) and English (Pitman). A comparison was made with reference to accuracy and rapidity in the three cases. Special contractions depending on the particular language employed were also illustrated. As a further test in order that no advantage should be given to either, each of the systems was applied to a strictly phonographic tongue (Polynesian) outside of the Indo-European family of languages. The conclusion was that English shorthand is the most philosophical, the French the simplest, and the German the most vigorous.

MR. R. A. HARRIS, of the U. S. Coast and Geodetic Survey, read a paper the objects of which were "To show in a non-mathematical way what simple oscillations go to make up the complex tidal wave; to give a short account of the harmonic treatment of tides, and to describe briefly certain mechanical aids which are, or may be, used in connection with the analysis and prediction of tides."

The principal tidal components were pointed out by considering what their 'speeds' must be in order to cause them to gain or lose one oscillation on a component having a 'speed' equal to the apparent diurnal motion of the moon or sun, or twice this motion, after the the lapse of certain times, as a tropical month or year, an anomalistic month or year, a half tropical month or year, a half synodical month, etc.

A sample was shown of the perforated sheets devised by Mr. L. P. Shidy, of the Survey, and styled 'stencils,' which have been in constant use for upwards of ten years. They indicate how the hourly heights are to be combined in the various kinds of summation, and so do away with the necessity of copying and recopying the tabular values.

A design of an adding apparatus to be governed by a stencil sheet embracing, side by side, all components to be summed for was shown. This, if constructed, would enable a person to sum simultaneously for all components almost as rapidly as for a single one upon an ordinary adding machine. The stencil sheet does away with the necessity of the great variety of gears (representing 'speeds') found in the Thomson harmonic analyzer, and insures positive workings. In fact, there are but two kinds of gear wheels in the adding apparatus, one containing, say, 300 teeth each, and the other, serving as counters, containing 299. The number of wheels in each of these two sets is 24 times the number of components to be summed for. Each 54 partial sums thus obtained are then to be analyzed in the usual way.

Brief mention was made of the predicting machines already constructed, and comparisons were made with the one now being built by the Survey.

BERNARD R. GREEN,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

THE meeting of this Society of April 8th was devoted to a general discussion of the subject of the application of stratigraphy and paleontology in determining subdivisions of geologic time.

The broad problems involved in the announced topic were primarily presented by Mr. Whitman Cross in a concrete case. He described the present state of knowledge regarding the formations of the Rocky Mountain region belonging to the periods between the Marine Cretaceous and the Wasatch Eocene, including the Laramie, Arapahoe, Denver, Ft. Union and Puerco. The statigraphic relations as at present known were described, and then the facts of the fossil floras, the invertebrate and the vertebrate faunas, were summarized. From the facts given it appears that the geologist investigating the formations of the group named is confronted by much conflict of evidence as to the relative importance of the time intervals separating the epochs of sedimentation. This is especially true in respect to the drawing of a line between the Mesozoic and Cenozoic in this region. The conflict of evidence in this instance was cited to show the necessity for a careful examination as to the nature of the connection between great faunal changes and the contemporaneous events of stratigraphic history. It appears that all forms of life were able to survive the period of great orographic disturbance at the close of the Laramie proper without radical change and that the dominant vertebrate life of the Post-Laramie disappeared at the close of that epoch from causes as yet unknown, which did not affect in any corresponding degree the contemporaneous plant and invertebrate life.

Mr. F. H. Knowlton presented a review of the fossil floras of the Laramie, Arapahoe, Denver and Fort Union formations, showing the strong distinctive characters of each and also their intimate relationship. This evidence fails to indicate any one break of supreme imimportance in this series of epochs.

Mr. T. W. Stanton reviewed in a similar manner the known invertebrate life of the upper Cretaceous and lower Eocene deposits of the Rocky Mountain region. The termination of true marine conditions was deemed to be the only safe criterion from this evidence to be applied in drawing a boundary for Mesozoic time.

A comparison of the vertebrate faunas of the Post-Laramie, Puerco and Wasatch formations, by Prof. W. B. Scott, of Princeton, was read by Mr. Cross. This brought out the remarkable differences in the vertebrate life of the three epochs, and also the impossibility of explaining the abrupt changes in these faunas from our present knowledge of attendant conditions.

Mr. F. V. Coville gave a review of the conditions affecting the distribution and changes in *living* floras, starting with the great controlling factors, heat and moisture, and making suggestions as to the applicability of these data to geological history.

Dr. C. Hart Merriam similarly described the conditions most affecting the distribution or causing modifications of terrestrial vertebrate life of the present, and discussed the apparent application of these facts to the past.

Mr. Bailey Willis referred to the variable relations which might exist between angular unconformity and otherwise important stratigraphic breaks.

Mr. R. T. Hill briefly referred to the development of knowledge of the Lower Cretaceous series of Texas, to which he had given twenty years' study, and brought out facts that bore in a general way on the subject under discussion.

W. F. Morsell.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

The 248th regular meeting of the Society was held April 7, 1896.

Dr. Arthur MacDonald read a paper entitled *Psycho-Neural Measurements of Human Beings with Illustrations and Experiments.*

Introduction: Philosophy in the old sense is almost impossible; no one man can have sufficient insight into the different sciences to understand their relations and make judgment of their content. Specialism may narrow a man, but it deepens his knowledge. Knowledge is so dovetailed together that a specialty studied thoroughly necessitates the investigation of the nearest lying branches. Generalism is liable to be superficial. The habit of studying one thing thoroughly is the method of specialism and is directly practical. The desire to include the universe may be called *generalism.*

Facts about the nervous system of man are

as important as facts about stones, plants and animals; yet there is, perhaps, the least definite knowledge about man. The scientific study of man in an experimental way is in its beginning. A man should *investigate* fifty times as much as he *writes*, and not *vice versa*.

Breathing.—Experiments with Ludwig's kymographion, the pneumograph and the Cambridge tambour, as made by Dr. MacDonald on four school children and three adults, seemed to indicate that concentration of mind or emotion lessens breathing. The effect between pathetic and lively music is noticeable.

Circulation.—In a somewhat extended experiment on a reporter with his newly constructed plethysmograph Dr. MacDonald found that: (1) By applying the algometer to the temporal muscle there was a decrease of flow of blood in the arm. (2) By passing a galvanic current through the brain, causing a pain like the prick of a pin, the effect was a decrease of flow of blood in the arm.

Fatigue.—By experiments on two women and two men with Mosso's Ergograph the results of Lombard were confirmed, to wit, that the recovery of the power of the finger after fatigue owes its periodicity to fatigue.

Dr. MacDonald illustrated with instruments of his own and those of others quantitative measurements of sensibilities of smell, heat, locality, pain and muscular judgments.

The second paper was by Dr. Thos. Wilson on 'Marriage in Nature and in Law.'

J. H. McCORMICK,
General Secretary.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, APRIL 7, 1896.

THE Mineralogical and Geological Section having precedence, M. Jos. Willcox described the process of obtaining quartz from the Oriskany sandstone of Pennsylvania to be used in the manufacture of glass. Mr. Keeley stated that the bed used for the purpose extends southward through Bedford county, where the material can be used without crushing, as it crumbles when exposed to the air.

Prof. Carter suggested the use of stone from the Conshohocken quarries as a source of silica. When dissolved in hydrocholic acid the stone yields flattened, transparent grains of silica, not at all colored by iron. The percentage of mica is small, the glistening appearance of the rock being due to the presence of silica.

Mr. Geo. Vaux, Jr., called attention to recent additions to the William S. Vaux collection, which included superb crystals of calcite from the Joplin region, Missouri. They occur in caves opened for the working of lead and zinc. The several mines are characterized by distinct forms of the mineral. The sphalerite which is largely present is being desited at the present time, the handles of shovels and picks left in the mines being covered with crystals. Unfortunately these had all been thrown into the reducing furnace and destroyed.

Mr. Theodore D. Rand described a fine collection of polished serpentines presented by him to the Academy from numerous localities in southeastern Pennsylvania. They belong to two groups: one bordering the ancient gneiss, the other, and the more recent, occurring in the mica-schists and gneisses. The former are altered igneous rocks, either chrysolitic or pyroxenic, the chief material being enstatite. The sources of the several forms were traced.

Dr. Florence Bascom reported the microscopic examination of thin sections of serpentine from the Black Rocks of Lower Merion. The mineral from this localit · has been derived from crysolite. That from the Conshohocken dyke is composed of diabase having the feldspar crystals in the lath-like form characteristic of that rock.

It was announced that Mr. G. Frederic Russell, accompanied by Dr. Querch and a taxidermist, had started from Georgetown, British Guiana, March 11th, on a collecting tour in the interior for the benefit of the Academy.

EDWARD J. NOLAN,
Recording Secretary.

NEW YORK ACADEMY OF SCIENCES, SECTION OF ASTRONOMY AND PHYSICS.

AT the regular meeting, held on April 6, 1896, the following program was presented before the section, Prof. J. K. Rees presiding:

The first paper was by Mr. P. H. Dudley, on the following title: 'The Law of Deflection Sets Under Drop Tests in Different Sections of

Steel Rails of Uniform Physical Properties Follows the Comparative Moments of Inertia of the Respective Sections.' Mr. Dudley described the improvements in the manufacture of steel rails which has been carried out under his direction during the last five years. The object was to produce a much stiffer rail than that which had been previously employed, and at the same time to make one out of a higher grade of steel. The rails have now been in use several years on the Boston & Albany and New York Central railroads, and they show a marked improvement over the old patterns in that the deflections have been decidedly lessened. Careful records of them have been kept by means of Mr. Dudley's track inspection machine. A great deal of information has also been accumulated by Mr. Dudley in connection with the tests of samples from each heat of steel in the process of manufacture. The full paper will be subsequently published by the Academy.

In the absence of Prof. Jacoby the contents of his paper on 'The Permanence of the Rutherfurd Photographs' were briefly summarized by Prof. Rees. Recent and very careful measurements made upon Rutherfurd negatives, which had been developed twenty or thirty years ago and which had been measured five to ten years ago, show absolutely no change in the plates, so far as could be detected. The film remains in the same part of the glass as when first studied. The negatives were made upon wet plates, and the speaker remarked that it remains to be shown whether the newer dry plates afford the same permanence.

The next paper was by Prof. J. K. Rees, on: (1) 'The Harvard College Observatory photographs of star clusters, planets, variable stars and stellar spectra.' (2) 'Prof. J. E. Keeler's photographs of planetary spectra.' Prof. Rees exhibited a large series of photographs of various astronomical subjects, which had been loaned by Prof. Pickering, of the Harvard Observatory, for the recent exhibition of the New York Academy of Sciences. He also threw upon the screen, by means of the lantern, a series of photographs of star clusters which included variable stars, and which show these variables at different periods. The originals were taken at the Harvard Observatory.

In the second part of his paper Prof. Rees threw upon the screen enlargements from photographs of stellar spectra which had been taken by Prof. Keeler, of the Observatory at Allegheny, Pa. The photographs of the spectra of Saturn were also shown, which prove that the ring about the planet is due to a stream of meteorites.

The last paper of the evening was the following by Prof. M. I. Pupin: 'Communication of some new Results of Experiments with the Röntgen rays.' This paper was printed in full in Science. April 10. Experimental demonstration of the points advanced was subsequently made for the members of the Academy in Prof. Pupin's laboratory.

J. F. Kemp,
Secretary.

NORTHWESTERN UNIVERSITY SCIENCE CLUB.

At the meeting of March 6th, Dr. Marcy in the chair, papers were presented by the Department of Mathematics.

Prof. Holgate gave the 'Problem of the Eight Queens,' which is so to place eight queens on a chessboard that no one will be endangered by any other, or, in general, to place n pieces on a square board so that no two will be in the same row, same column, or same diagonal. This problem was first proposed by Nauck to Gauss, was the subject of correspondence between Gauss and Schumacher and was finally solved by Gauss in 1850. In 1874 Günther suggested a solution of which Glaisher made use in a solution which he published that year in the Philosophical Magazine. Dr. Holgate presented Glaisher's solution in full.

Prof. White presented Poncelet's problem concerning polygons that possess both an inscribed and circumscribed conic. The parametric representations of the points of a conic, the doubly quadric relations of pairs of points, and the statement of periodic relations of this kind by the aid of elliptic functions, were treated in the manner of Euler, Jacobi and Hurwitz.

A. R. Crook,
Secretary.

Evanston, Ill.

Erratum:—On page 604, paragraph 2, line 2, for *Instinct* read *Insect.*